AGRICULTURAL LAND BASE STUDY:

DEVELOPMENT OPPORTUNITIES FOR THE FUTURE

ANALYSIS OF IMPACTS ON OTHER RESOURCES

Alberta
Agriculture
Environment
Forestry, Lands and Wildlife
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ANALYSIS OF IMPACTS ON OTHER RESOURCES

FOREWARD

The Agricultural Land Base Study (ALBS) is an interdepartmental study undertaken by Alberta Agriculture, Environment, Forestry, Lands and Wildlife, Municipal Affairs, and Transportation. The study is designed as a long-range planning tool for future agricultural development and is not an implementation study. The contents of this report analyze the effects of ten agricultural development opportunities on other resources uses.

Impacts on other resource uses are just one of the criteria which the ALB study is using to evaluate these development opportunities. Any significant initiative to more effectively manage Alberta's land and water resources for agriculture needs to consider a number of approaches and their impacts, physical and economic, on other resource uses. The physical impact analysis report represent one component of the Agricultural Land Base Study. Conclusions can only be drawn in collective consideration of each of the following background reports:

- Government Programs Promoting Agricultural Expansion and Intensification
- Agricultural Inventory
- Economic and Financial Analysis: Direct Benefits and Costs
- Economic Impact Analysis
- ALBS: Summary Report

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AGRICULTURAL LAND BASE STUDY

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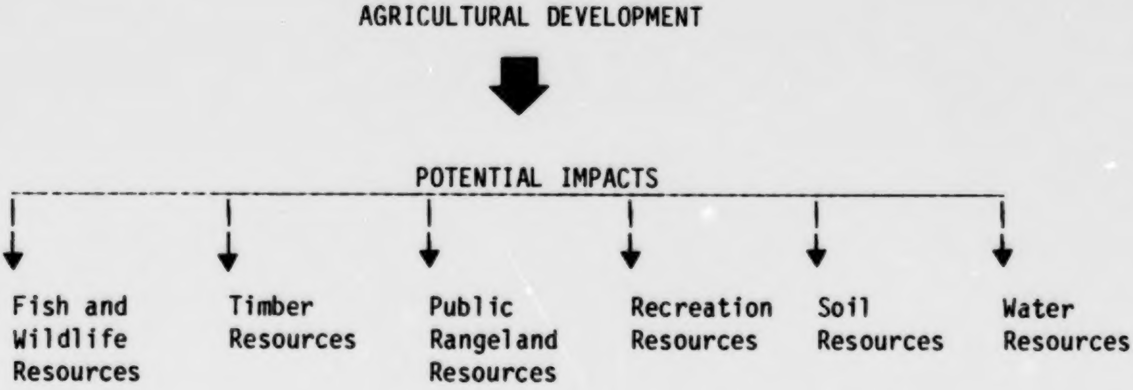
EXECUTIVE SUMMARY

Projections regarding future levels of agricultural production or the amount of land required for agriculture are difficult to make, but it can be stated that competing land uses, soil deterioration and natural limitations all act to constrain projected increases. Land and water resources are finite, and uses that compete with agriculture must be accounted for in the pursuit of agricultural development. The Analysis of Impacts on Other Resources report forms one component of the Agricultural Land Base Study (ALBS).

Alberta's biophysical environment provides a common resource base for various land and water uses. Alternative uses compete for this resource base, with gains for one often becoming a loss to others. Impacts are defined as changes to the biophysical environment attributed to agricultural development or management changes. The objective of the Analysis of Impacts on Other Resources report is to quantify measureable impacts of agricultural development and to describe expected effects where quantifiable information is not available. The physical impact analysis considers only primary effects and is conducted from a "worst-case scenario" perspective, assuming zero or minimal mitigative measures. It is recognized, however, that where possible a number of actions may be taken to ensure the discussed impacts do not occur or are minimized.

Impacts are assessed for six resource sectors. Government agencies with specific resource management responsibilities assessed the potential consequences of agricultural development on resources under their mandate listed below.


AGRICULTURAL DEVELOPMENT
POTENTIAL IMPACTS
Fish and Wildlife Resources
Timber Resources
Public Rangeland Resources
Recreation Resources
Soil Resources
Water Resources

The Agricultural Land Base Study considers ten development alternatives that deal with physical improvements in land and water management for agricultural use.

1. Green Area Conversion;
2. Irrigation Expansion;
3. Drainage,
4. Deep Plowing
5. Liming;
6. Summerfallow Reduction;
7. Range Improvement;
8. Prairie Range Conversion;
9. Woodland Conversion;
10. Saline Soil Reclamation

1. GREEN AREA CONVERSION

The expansion of agriculture onto 9.2 million acres of agricultural land in the Green Area would have major impacts on fish and wildlife, timber, rangeland, recreation, soil and water resources. These effects would be concentrated in the northwest region of the province.

The development of 9.2 million acres of land in the Green Area for agriculture would reduce the amount of non-agricultural land in the Peace River Region by 18 percent. Smaller portions of the non-agricultural land base in the Eastern Slopes and the Northeast Regions would also be affected. The Boreal Mixedwood and Boreal Foothills habitat regions would lose 15 and 22 per cent respectively of their non-agricultural land base. Ten per cent of all non-agricultural land in the province would be taken up. Expansion would be detrimental to approximately 71 per cent of all resident mammal species and 54 per cent of all resident breeding bird species in the Green Area. As an example, the loss of first and second class moose habitat through expansion would result in a lost capability for maintaining approximately 39 000 moose. This represents a 23 per cent decline in overall provincial capability. Similarly, some species which are especially vulnerable to human activities, such as grizzly bear and caribou, would have their range in Alberta considerably reduced by expansion. The capability to produce fish in many northern and central Alberta streams, rivers and lakes wouild also be negatively affected. This alternative would be beneficial to a number of wildlife species. For example, the provincial capability for white-tailed deer would increase by approximately 10 000 animals, during extended periods of favorable climate. Many species classed as agricultural pests would also benefit from expansion. Expansion would likely have a significant negative affect on the ability to consumptively and non-consumptively use wildlife resources in the Peace River Region. It would be more difficult to view and harvest many species as these human activities are forced to shift to non-productive habitats with resident wildlife populations at very low densities. Expansion at this scale would likely require a life style change for trappers, guides and other individuals who make their living from the fish and wildlife resource.

The agricultural expansion alternative would affect about 10 per cent of Alberta's coniferous Annual Allowable Cut (AAC), while the loss of deciduous AAC would be about 24 per cent. Losses of committed coniferous AAC would be as high as 24 per cent in Slave Lake and Whitecourt Forests, while the losses of committed deciduous AAC would be about 46 per cent in Grande Prairie Forest and 37 per cent in Slave Lake Forest. Forest Management Agreements would also be negatively affected by expansion onto 9.2 million acres in the Green Area. For example, Canadian Forest Products Ltd. would lose about 36 per cent of their coniferous and 49 per cent of their deciduous AAC.

Approximately 22 600 Animal Unit Months (AUMs) of grazing capacity would be lost to agricultural expansion. This loss represents about 17 percent of the total current grazing activity in the Green Area. The major reduction, about 9 000 AUMs, would be in the Grande Prairie Forest.

Impacts on potential or existing Alberta Forest Service recreation sites are difficult to assess at this scale, and should only be evaluated on a site-specific basis. In general, however, the quality of recreation resources would be reduced through lowered water quality, reduced aesthetic values and conflicts between agriculture and dispersed recreation activities.

The combination of fine textured soil, undulating topography with deeply incised river channels and moisture conditions make much of the area capable for agricultural expansion susceptible to erosion. The most sensitive land would be areas of grey luvisols (as opposed to dark grey) and areas of greatest relief south and west of Grande Prairie and south and east of the Swan Hills. Research has concluded (Chanasyk and Woytowich 1984) that the thin topsoil layer and severe climate of northwest Alberta result in slow rates of soil formation and therefore productive capability can easily be destroyed by erosion.

The implications of increased soil erosion extend beyond the farmer's field, since much of the soil removed eventually finds its way into watercourses. Erosion may produce increased sediment and nutrient loading in area watercourses, and gradual water quality deterioration related to eutrophication and turbidity. Agricultural development of Green Area land would result in major impacts on the streams, rivers and lakes of northwest Alberta. Land clearing and drainage of wetlands increases runoff and reduces storage thereby resulting in higher flood flows and more extreme low flows.

2. IRRIGATION EXPANSION

Approximately 8.9 million acres in the southern third of the province have a fair to good physical potential for irrigation. The availability of water for irrigation is the major limiting factor for irrigation expansion. The impacts of irrigation expansion on fisheries, water quality and recreation were taken largely from the South Saskatchewan River Basin Study (Alberta Environment 1985). For the purpose of the Agricultural Land Base Study, the maximum area of irrigation expansion is 1.1 million acres.

If Irrigation Expansion was directed primarily towards current non-agricultural land it would take up 16 per cent and four per cent of all non-agricultural land in the Southern and Central Regions respectively. Expansion would take up non-agricultural land in five habitat regions with the loss being greatest in the Shortgrass Prairie (16 per cent decline). Irrigation of current non-agricultural land would negatively influence most wildlife species currently found in central and southern Alberta. Approximately 62 per cent of all mammals and 68 per cent of all breeding bird species found in the prairie habitat regions of Alberta would be negatively affected. A 22 per cent decline in the capability to produce antelope in the Southern Region and an 18 per cent decline in overall provincial capability would result from implementing this agricultural alternative. Many other species found in central and southern Alberta would show similar declines as a result of irrigation expansion. Irrigation expansion onto current dryland farming areas would have a relatively small effect on wildlife. Indeed if the margins of the newly irrigated fields are maintained in an undeveloped state, then a number of species would substantially benefit from the increased forage production associated with irrigation. However, irrigation of current dryland farming areas would be a largely negative influence to most species if irrigation farming practices are more intensive than the prior dryland farming practices. Fish habitat may be enhanced by the regulation of stream flows, however in reaches where flows are more variable habitat quality would be reduced.

In terms of water quality there is a potential for severe impacts particularly in the lower reaches of the Bow and Oldman Rivers. It must be noted that water quality in all potentially impacted rivers, particularly downstream reaches, is generally poor at the present time. The major recreational effects are on boating, as a result of low water levels. There would be major water level changes in the Ghost, Keho and St. Mary reservoirs. Two of the most important impacts of Irrigation Expansion would be on soil salinity and water quality, resulting from the effects of drainage effluent.

Approximately 762 000 acres of public land in southern Alberta is potentially irrigable. This represents approximately ten percent of the total public rangelands in the White Area or approximately 20 per cent of the public rangelands in the Southern Region. The majority of this land is in the Brown soil zone and if converted could potentially result in the loss of approximately 126 000 AUMs on public rangeland or about eight per cent of the provincial total. This loss of rangeland could affect the traditional ranching lifestyle of southern Alberta. Irrigation Expansion could also impact land tenure and use in the Special Areas where approximately 200 000 acres are potentially irrigable. It is not possible to estimate how much public land could be affected by irrigation, but it would likely be small in comparison to the amount of current private farm land affected.

3. DRAINAGE

The assessment of agricultural drainage potential was carried out by the Drainage Potential in Alberta - An Integrated Study. This study was designed to inventory and classify agricultural lands in the provincial White Area having excess moisture problems and determine which of these areas may be drained.

Approximately 2.1 million acres of non-permanent wetlands were identified as being suitable for drainage. This represents 22 per cent of all wetlands found northcentral and northwestern Alberta. An additional 2.7 million acres of potentially drainable peatlands (bogs and fens) were also identified. However these peatlands have been excluded from all subsequent analyses.

Non-permanent wetlands represent 80 per cent of all wetlands in the central, 25 per cent in the northeast and 10 per cent in the Peace River Administration regions. Significant impacts were associated with wetland drainage in each of these regions. Wetlands in the Parkland and Prairie Habitat regions would be most affected by drainage. Significant regional reductions would also occur in the Boreal Mixedwood and Foothills regions. Somewhat less severe declines would occur throughout the remaining habitat regions. Approximately 80 per cent of all mammal and breeding bird species in these habitat regions would be negatively affected by drainage. Negative effects would also occur for significant numbers of non-breeding and migrant bird species. Low to moderate declines in moose, white-tailed and mule deer populations were recorded for northcentral Alberta. The drainage of 2.1 million acres of non-permanent wetlands could result in the loss of 9 million ducks from the average fall flight of Alberta produced ducks. This loss represents 54 per cent of the current provincial fall flight.

4. DEEP PLOWING

No potential impacts on other resources have been identified.

5. LIMING

No potential impacts on other resources have been identified.

6. SUMMERFALLOW REDUCTION

Estimates show that by 1990 the provincial summerfallow acreage could be reduced by 1.4 million acres. This land would therefore be made available for field crop production annually. This reduction in summerfallowing would have a positive impact on the amount of land adversely affected by wind erosion.

The practise of summerfallowing increases the incidence of wind erosion. Summerfallowing exposes soil to wind whereas vegetative cover or crop residue helps to protect soils from wind. There is a potential to decrease the most adverse effects of wind erosion on all of the 900 000 acres located in the Brown and Dark Brown soil zones of southern Alberta through summerfallow reduction.

7. RANGE IMPROVEMENT

Range Improvement would affect fish and wildlife, timber, rangeland and water resources. Impacts from prairie range improvement (1.0 million acres) would occur in southern Alberta while the effects of woodland range improvement (0.4 million acres) would occur in the northern and central portions of the province.

Prairie Range Improvement would take up approximately 0.5 million acres of non-agricultural land in the Central Region of Alberta (11 percent of all non-agricultural land) and approximately 0.4 million acres in the Southern Region (eight percent of all non-agricultural land). Prairie Range Improvement would remove non-agricultural land in six habitat regions with the greatest effects realized in the Mixedgrass Prairie and Montane habitat regions (15 per cent decline and 14 per cent decline respectively). Woodland Range Improvement would affect a very small percentage of the non-agricultural land base of the Central, Eastern Slopes, Peace River and Northeast regions. This development would, however, still remove approximately 0.25 million acres of non-agricultural land from the Northeast Region. Both Prairie and Woodland Range Improvement would have a generally negative affect on wildlife species. Prairie Range Improvement would negatively affect, to some degree, approximately 47 per cent of all mammal and all breeding bird species found in southern and central Alberta. Woodland Range Improvement would negatively affect a somewhat larger number of species. A negative effect would be realized for approximately 64 per cent of all mammal species and approximately 68 per cent of all breeding bird species found in developable areas of central and northern Alberta. Declines in habitat quality would substantially reduce the capability of the Southern and Central Regions to produce several affected ungulate species. Reductions would, however, have only a small effect on the provincial potential to produce these species. Woodland Range Improvement would tend to reduce the availability of wildlife populations on a local scale with a small impact on wildlife at a regional and provincial scale.

Alberta Forest Service community farm woodlots in the Eastern Slopes and in northwest Alberta could be impacted by large scale Range Improvement. In all cases, one quarter or less of the woodlots would be affected and these effects would be localized.

There are approximately 1.5 million acres of CLI class 5 public land currently disposed to grazing, while about 20 to 25 per cent of this could respond to improvement. The Range Improvement alternative could potentially increase grazing on public land by approximately 224 600 AUMs. This is a 12 per cent increase in the number of AUMs on public land. Public lands could contribute approximately 21 per cent of the total provincial increase of 1.07 million AUMs associated with this development alternative. The actual number of increased cattle would depend on grazing season and management.

Impacts on water quality would occur in the form of increased phosphorus loadings produced by higher livestock concentrations. The level of increased phosphorus loading produces algae blooms in streams and lakes which causes summer and winter kill of fish and accelerates eutrophication (deterioration) of the water body. The severity of impact is proportional to the concentration of cattle and the current status of water quality.

8. PRAIRIE RANGE CONVERSION

The Range Conversion alternative would potentially affect fish and wildlife, rangeland, soil and water resources in southern Alberta. It is estimated that 3.5 million acres have a potential for range conversion.

Range conversion would affect only three per cent of all non-agricultural land in the province, however, it would affect 38 per cent of all non-agricultural land in the Southern Region and 24 per cent of all such land in the Central Region. Conversion would take up a significant amount of non-agricultural land in the Shortgrass Prairie (28 per cent decline in current non-agricultural land), Aspen Parkland (29 per cent decline), Mixedgrass Prairie (36 per cent decline) and Fescue Grasslands (60 per cent decline). This alternative would constitute some degree of a negative impact for approximately 68 per cent of all mammal species and 64 per cent of all breeding bird species found in these three prairie habitat regions of the province. A negative effect would occur for a smaller proportion of all mammal and breeding bird species found in the Aspen Parkland and Montane Habitat Regions. Habitat degradation through Range Conversion would significantly reduce the production capability for antelope, white-tailed deer and mule deer in central and southern Alberta. It is likely that many wildlife species, which use habitat attributes similar to one of the above species will experience population declines similar to one of these ungulates as a result of conversion. As an example, Sage grouse could be lost from 36 per cent of their current range in Alberta following Range Conversion. Sage grouse use many habitat features also used by antelope. In general, Range Conversion would negatively affect stream and lake fisheries in central and southern Alberta.

The conversion of suitable public land presently disposed to grazing could remove 110 000 AUMs or approximately 6 per cent of the total AUMs on public land in the White Area. This conversion of 455 000 acres of public land represent about 6 per cent of the total in the White Area. Grazing losses on public lands represent approximately 12 per cent of the total grazing losses estimated for Range Conversion. Also important could be changes to the traditional ranching lifestyle.

The breaking of soil (i.e. cultivation of predominantly CLI class 4 land) for crop production would increase the regional potential for soil erosion. It is likely that these lands could be as or more susceptible than currently developed land. Approximately 800 000 to 1 000 000 acres of land, 10 per cent of the total cultivated area, were affected by wind erosion in 1985. Applying the same ratio, Range Conversion could potentially increase the area affected by wind erosion by an additional 30 per cent. The removal of protective vegetation can also expose soil to the erosive effects of water. The consequence of increased water erosion of soil would be increased sediment and nutrient loads in area streams and rivers.

9. WOODLAND CONVERSION

The Woodland Conversion alternative would affect fish and wildlife, timber, rangeland, soil and water resources. These effects would be concentrated in the Eastern Slopes and northwest Alberta. It is estimated at 7.1 million acres have a potential for Woodland Conversion.

Woodland Conversion would affect two distinct types of unimproved land. Conversion would take up approximately 6.2 million acres of large contiguous areas of non-agricultural land and in addition would affect approximately 900 000 acres of hedgerows, small woodlots and other residual non-cultivated parcels found within areas currently improved for agriculture. Conversion of large areas of woodland would remove only six percent of all non-agricultural land in the province, however this is approximately one third of all non-agricultural land currently found in the provincial White Area. Substantial regional declines would occur in the amount of non-agricultural land available in the White Area of the Peace River (86 per cent decline), Northeast (41 per cent decline) and Eastern Slopes (26 per cent decline) Regions. Considering the province as a whole, conversion of large areas of woodland would take up 28 per cent of all non-agricultural land in the Aspen Parkland and 10 per cent of all such land in the Boreal Mixedwood. Perhaps most important, conversion of residual woodlands would remove all woodland areas from 6.0 million acres of improved farmlands in the Northeast Region, 3.7 million acres of all such land in the Peace River Region and 2.3 million acres of all such land in the Central Region. Most residual Woodland Conversion would occur in the Aspen Parkland and Boreal Mixedwood habitat regions. Woodland Conversion would constitute some degree of a negative impact for approximately 79 per cent of all mammal species and all breeding bird species found in central and northern Alberta. Conversion would result in a lost potential for approximately 21 000 moose, 18 000 mule deer and 32 000 white-tailed deer. Regional declines for these species in habitat quality and population capability would be substantial in the Northeast, Peace River and Central Regions. Conversion would make it more difficult for people in the population centres of central and northern Alberta to access wildlife populations and large contiguous areas of wildlife habitat. In addition, conversion of residual woodlands would leave large areas of farmland devoid of habitat for many bird and mammal species. This alternative would eliminate or reduce the quality of many fisheries currently accessable to residents of northern and central Alberta.

Effects of Woodland Conversion on timber would be localized and limited to small areas of eight existing and two potential community farmwoodlots (CFW). The exception is Edson CFW which could lose 50 per cent of its total area.

Grazing on public land would be reduced by 350 000 acres or 61 500 AUMs (3 and 5 per cent of provincial totals respectively). These losses would be more prevalent in the Northeast and Peace River Regions than in other areas of the province. Grazing losses on public land represent approximately 5 per cent of the total grazing losses estimated for Woodland Conversion.

The major impacts on water resources would result from increased clearing and cultivation. This could lead to decreased water quality caused by erosion and changed streamflow regimes in affected drainage basins. Some particularly sensitive areas are southwest of Lesser Slave Lake, the Smoky River Basin, Lake Wabamun and Lac St. Anne. Phosphorus loadings could also be a concern.

10. SALINE SOIL RECLAMATION

The reclamation of 0.25 million acres of irrigated saline soils has been shown to have potential detrimental effects on receiving streams through subsurface drainage. This is the result of poor quality effluents. No potential impacts on other resources have been identified for the reclamation of 2.22 million acres of dryland saline soils.

11. SUMMARY

The impacts of ten agricultural development alternatives have been assessed for six other resource sectors. There is a problem with comparing these impacts because of the nature of the various sectors and availability of data to quantify effects. Therefore the loss of an acre of wildlife habitat, an acre of committed timber, an inch of topsoil and so on, are not directly comparable. The Economic Impact Analysis reduces many, but not all, of these impacts to dollar values and therefore provides one way to compare impacts.

A comparison of impacts from each alternative was provided for this report by each participating agency. Each agency rated the magnitude of impacts from each alternative as insignificant, low, medium or high. These ratings are rather subjective but provide an approach, even though not perfect, to summarize and compare the severity of impacts described in the report. These ratings are shown in the following table.

As can be seen from the table, no impacts were identified for Deep Plowing and Liming. Summerfallow reduction could have positive effects for reducing soil erosion and Saline Soil Reclamation could have only moderate impacts on Water Resources. Impacts from Range Improvement are considered to be small or insignificant from the provincial perspective. Green Area Conversion, Irrigation Expansion, Prairie Range Conversion, Woodland Conversion and Drainage could each have at least very large impacts on other resource sectors in Alberta.

The potential effects of each agricultural alternative on fish and wildlife resources were assessed by first determining the impacts on the non-agricultural or unimproved agricultural land base in the province. Secondly, these effects on habitat were then interpreted for several important species. The ratings under the fish and wildlife resource column are therefore comparative weightings of habitat and population implications of each alternative.

The ranking of impacts under the Timber Resources column were determined based on the extent to which agricultural development would affect the province's ability to provide timber on a sustained basis. The impact of Green Area Conversion on timber management in the Green Area is very large in terms of area of land affected and effects on committed timber. Timber management effects of Range Improvement and Woodland Conversion are of less significance provincially but could be very important to local users of Community Farm Woodlots.

SUMMARY OF AGRICULTURAL ALTERNATIVES THAT COULD AFFECT OTHER RESOURCES

	Fish and Wildlife Resources	Timber Resources	Public Rangeland Resources	Recreation Resources	Soil Resources	Water Resources
Green Area Conversion	H*	H	M	L	H	H
Irrigation Expansion	M	--	L	L	M	H
Drainage	H	--	--	--	L	H
Deep Plowing	--	--	--	--	--	--
Liming	--	--	--	--	--	--
Summerfallow Reduction	L(+)	--	--	--	M(+)	--
Range Improvement	M	L	L(+)	--	--	L
Prairie Range Conversion	H	--	L	--	H	M
Woodland Conversion	H	M	L	--	H	H
Saline Soil Reclamation	L	--	--	--	--	M

* H = High Impact
M = Medium Impact
L = Low Impact (+ = positive impact)
I = Insignificant
N/A= Data Not Available

NOTE: Each of these assessments were carried out by the Alberta government department responsible for management of the particular resource. These are qualitative assessments of provincial impacts from the agency's perspective. These ratings can be compared within columns (resource sectors) but should not be compared between resource sectors. These impacts are not additive.

The Alberta Forest Service assessed the impacts on grazing of Green Area Conversion while Public Lands Division determined the effects on grazing of other alternatives. Approximately 17 percent of current grazing in the Green Area could be affected by the expansion alternative and was rated moderate. All other alternatives affected less than 10 percent of grazing in the White Area and were therefore considered to be low. Perhaps most importantly, however, would be the potential effects on local areas and their traditional ranching lifestyle.

Impacts on Recreation Resources were determined to be low in all cases from a provincial standpoint, but in many cases impacts could be large at local scales. Land and water based recreation were considered. A number of the alternatives that affect wildlife and fisheries also affect consumptive and non-consumptive recreational uses but it was not possible as part of this study to estimate these effects.

The effects of alternatives on Soil Resources were addressed by Alberta Agriculture and Environment from the standpoints of soil erosion and quality. A large number of the alternatives could potentially affect Water Resources as determined by Alberta Environment. These effects were weighted comparatively based on water quality and water quantity considerations.

Large scale agricultural development could significantly affect the use of Alberta's land and water resources by other sectors and the conservation of those resources for future use. The potential impacts from each of the 10 development options in the Agricultural Land Base Study have been identified and described. Major impacts would be expected on wildlife and timber. Major impacts could also occur on soil and water resources if mitigation measures are not implemented. Relatively minor impacts could occur on public rangeland and recreation.

Significant positive impacts could be created by two of the development opportunities. Green Area Conversion would result in the development of a transportation and utility infrastructure in Northern Alberta which would benefit non-agricultural sectors. Irrigation Expansion would create a secure water supply for municipal and industrial users in Southern Alberta. It would lead to a stabilization of agricultural production and an increase in water based recreation opportunities. It could also improve soil quality in some salinized areas. However, at the provincial level, the potential exists for major negative impacts on wildlife and timber resources if alternatives such as Green Area Conversion, Irrigation Expansion, Drainage Woodland Conversion and Range Conversion are pursued. If implemented, mitigation and conservation measures could offset the impacts on soil and water resources and to some extent those on wildlife resources for those alternatives. Deep Plowing, Liming Soils and Summerfallow Reduction would produce no impacts while Range Improvement and the Reclamation of Saline Soils would produce lesser impacts on a small area of the land base.

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1. INTRODUCTION

Alberta's agricultural land base can be expanded into new areas, and its productivity can be increased by various land and water management techniques. Numerous studies have suggested different approaches to expanding agricultural production. These studies, however, have either focused on one approach, considered only a portion of the province, lacked comprehensive information or have been relatively unconcerned with the relationship that one approach may have on other resource sectors. Land and water are limited resources in Alberta and uses that compete with agricultural uses must be accounted for in the pursuit of agricultural development.

The need for more comprehensive policy on public and private agricultural resource development has led to the Agricultural Land Base Study (ALBS). The objectives of the study are:

1. To identify the natural resource management options available for the expansion and intensification of Alberta's agricultural land base.

2. To identify the location and the maximum potential increase in agricultural production achievable through the application of the management options.

3. To assess the relative economics of the management options.

4. To evaluate the impact of such management options on other natural resource sectors.

5. To identify existing government programs that promote the application of the management options.

The fourth objective defines the need for this report which assesses the interrelationships of agriculture and other land and water resource uses. The ten development alternatives evaluated by the Agricultural Land Base Study are:

1. Green Area Conversion
2. Irrigation Expansion
3. Drainage
4. Deep Plowing
5. Liming

6. Summerfallow Reduction
7. Range Improvement
8. Prairie Range Conversion
9. Woodland Conversion
10. Saline Soil Reclamation

Most land and water resources are suited for more than one use as they form the common base for agriculture, forestry, and recreation. Alberta's land and water resources are limited and increased agricultural development places stress on their ability to provide a variety of products and services. In many cases it is not possible to allocate land and water resources for agriculture, without affecting the ability of the resource base to provide other opportunities. Alternate uses compete for the same resources, with gains by one often becoming a loss to others. The expansion or intensification of agriculture almost always influences other resources in a negative manner, although in some cases changes may actually produce some benefits for other sectors.

The analysis of physical resource relationships is based on the area estimates and maps prepared by the agricultural inventory component of the ALBS. The inventory established the quantity of land available for each agricultural development alternative and mapped locations of these lands on 1:1 million maps. These maps provided the basis for other participating agencies to assess consequences on their resource management mandate. Effects were evaluated by the provincial government agencies having the appropriate resource management responsibilities.

2. SCOPE OF THE PROJECT

The ALBS is a broad level analysis of agricultural development alternatives. Guidelines for the study are listed below:

Area Included - See Figure 1.
- Land capability for cultivation - CLI 1-4;
- Land capable for improved grazing - CLI 5.
- The White Area and the portion of the Green Area classified for agriculture as CLI class 1-4.
- Irrigation - climatic zones A1, A2, B and C for irrigation expansion. (see Figure 11)

Area Excluded - See Figure 1.
- Urban jurisdictions.
- Major rural residential, industrial, commercial or institutional zones.
- National and Provincial Parks.
- Existing wildlife sanctuaries and ecological reserves.
- Military ranges.
- Indian reserves.
- CLI 6, 7, organic and non-classified lands.*

Scale - Estimates to the nearest 0.1 million acres are consistent with the study's provincial perspective.

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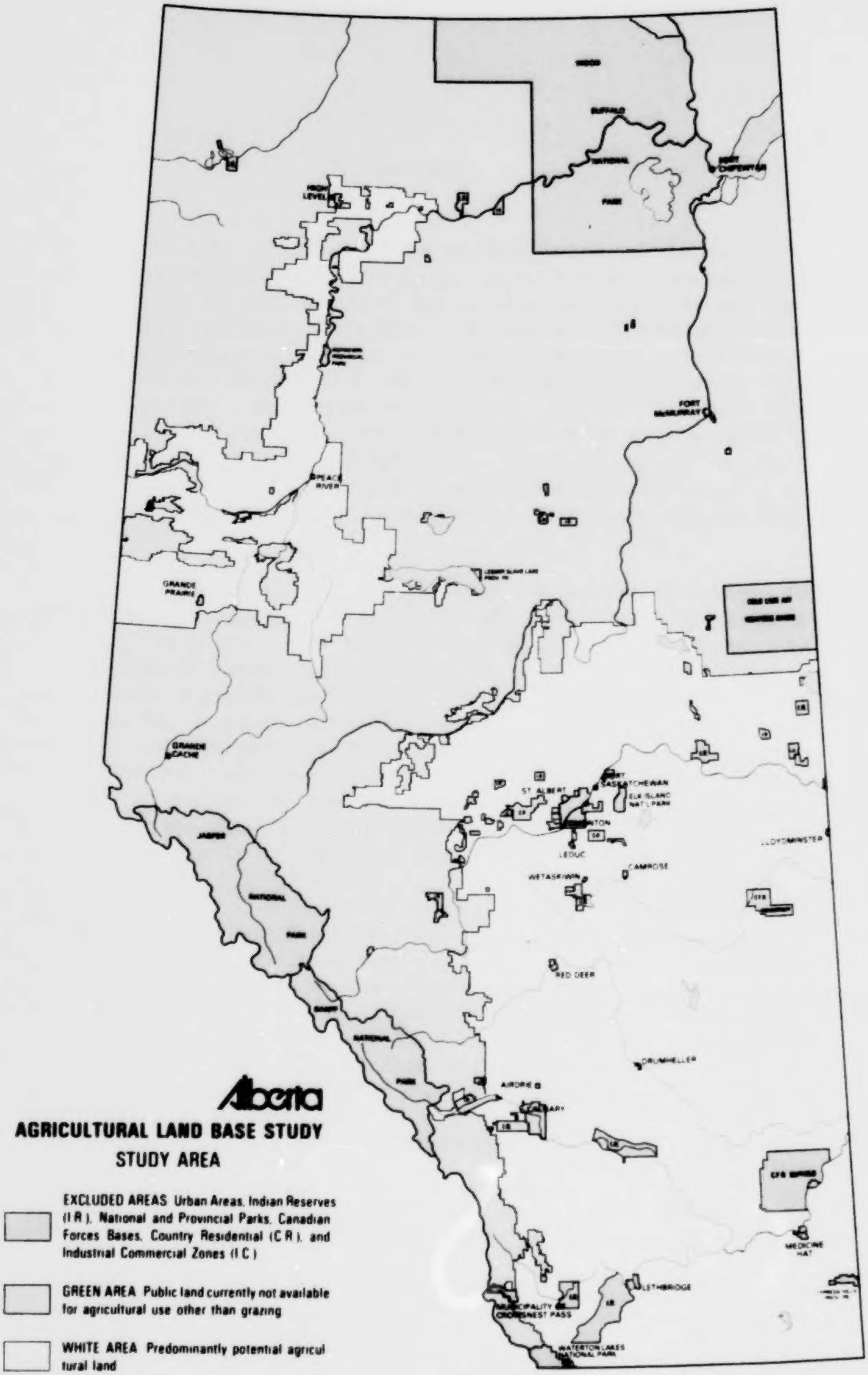
* Impacts on resources on these lands were considered in some cases. Agricultural activities on CLI 1-5 can influence resources on CLI 6, 7, O or non-classified land. Other resources on these lands were also documented as part of the current resource status.


WOOD
BUFFALO
NATIONAL
PARK
FORT CHIPEWYAN
HIGH LEVEL
FORT McMURRAY
PEACE RIVER
GRANDE PRAIRIE
GRANDE CACHE
JASPER
NATIONAL
PARK
ST. ALBERT
FORT SASKATCHEWAN
ELK ISLAND NAT'L PARK
EDMONTON
LEDUC
CAMROSE
WETASKIWIN
LLOYDMINSTER
RED DEER
DRUMHELLER
BANFF
NATIONAL
PARK
AIRDRIE
CALGARY
IR
CFB SUFFIELD
MEDICINE HAT
LETHBRIDGE
MUNICIPALITY CROWSNEST PASS
WATERTON LAKES NATIONAL PARK

Alberta

AGRICULTURAL LAND BASE STUDY

STUDY AREA

▨ **EXCLUDED AREAS** Urban Areas, Indian Reserves (I.R.), National and Provincial Parks, Canadian Forces Bases, Country Residential (C.R.), and Industrial Commercial Zones (I.C.)

▨ **GREEN AREA** Public land currently not available for agricultural use other than grazing

☐ **WHITE AREA** Predominantly potential agricultural land

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3. METHODS

The ALBS has investigated the maximum potential increases in agricultural production that could be realistically expected from implementing each of the ten development alternatives. To be consistent with this approach, the analysis of impacts has focussed on the maximum potential impacts that could result from these alternatives. The impact analysis therefore looks at polar extremes or worst case scenarios. In many cases impacts could be smaller if they were mitigated by withholding some land from development or implementing government programs to offset disbenefits. There is no way of estimating to what degree impacts could be offset through partial or complete mitigation of each alternative thereby justifying the approach described below.

For the purpose of the ALBS, impacts are defined as changes in the biophysical environment attributed to the agricultural development alternatives. They occur when the provision of products or services by other activities is restricted or enhanced. In some cases these interrelationships of resources and their use are subtle, implicit or poorly understood while in other cases they are well understood and can be quantified. The purpose of this analysis is to quantify effects wherever possible and to describe expected consequences where quantified information is not available. The analysis is only concerned with the impacts on the physical resource base; it is not concerned with impacts on the administration and management of these resources.

The physical impact analysis considers only primary effects of the 10 agricultural alternatives examined in the ALBS. Only relationships to other resources receiving current use have been addressed because the analysis of impacts on future or potential use are beyond the scope of this study. The timeframe imposed on the study limited the analysis to existing data sources and relationships that are well understood or described in the literature.

Impacts from the 10 agricultural alternatives have been assessed for:

1. fish and wildlife resources
2. timber resources

3 public rangeland resources
4. recreation resources
5. soil resources
6. water resources

In order to assess the effects associated with a certain alternative, it was first necessary to describe the area and location of land affected. The Agricultural Inventory component of the study provided this information. Participating agencies with specific resource management responsibilities then took this information and assessed the potential consequences agricultural development might have on resources under their mandate. Specific methods are described below in section 3.1 and results are provided in Chapters 4 to 13. Maps of land affected by each alternative at 1:1 million were relied upon heavily for the analysis of impacts on other resources. These maps were provided to overlay with resource information maintained by the responsible agencies. This made it possible for agencies to identify the quantity and location of effects from agricultural intensification or expansion on other resources and their use. The mapped values and impacts were adjusted to agree with the statistical information in cases where the mapped information varied from statistical numbers.

The initial area estimates in the Agricultural Inventory were made on the basis of published statistical data. Final or refined area estimates were made by various resource specialists taking into consideration agricultural capability, current agricultural use, regional environmental variations and current management practices. Provincial acreage statistics for each of the development alternatives are shown in Table 3.1.

The methods for estimating impacts of various agricultural development alternatives on other resources varied from sector to sector. These differences were mainly the result of data limitations and differences in the kinds of problems addressed, either from the perspective of the agricultural option or the resource being affected. The following sections describe the methods followed to determine the impacts on each resource sector.

Table 3.1

AREA ESTIMATES FOR EACH ALTERNATIVE

Management Options	Area Estimates (000 000 acres)
1. Green Area Conversion	9.2
2. Irrigation Expansion	1.1
3. Drainage	2.1
4. Deep Plowing	2.2
5. Liming	2.6
6. Summerfallow Reduction	1.4
7. Range Improvement [1]	1.4
8. Prairie Range Conversion	3.5
9. Woodland Conversion	7.1
10. Saline Soil Reclamation[2]	2.5

1. Range Improvement	- Prairie	1.0
	- Woodland	0.4
2. Saline Reclamation	- Irrigated	0.3
	- Dryland	2.2

3.1 Fish and Wildlife Resources

An examination was made of the potential impacts that six agricultural development alternatives could have on Alberta's fish and wildlife resources. These alternatives are: Green Area Conversion, Irrigation Expansion, Range Improvement, Prairie Range Conversion, and Woodland Conversion. Impacts were assessed by the Fish and Wildlife Division, Forestry, Lands and Wildlife.

In examining these agricultural alternatives it would be very difficult and inefficient to estimate how agricultural development would specifically affect each individual species in the province. The approach taken was to first describe how each alternative would change the non-agricultural or predominantly unimproved land base in given administrative (Figure 2)[1] and habitat regions (Figure 3). Based on these calculations, general statements were made as to the number and type of species that could potentially be affected by agricultural development. The fact that improved agricultural areas can provide important habitat for some species is recognized, but it is implicitly assumed that non-agricultural and unimproved areas are of prime importance to the majority of wildlife species.

The second component of the analysis deals in a more quantitative manner with a selected group of species and describes how each alternative would alter the potential of a given area for wildlife production. The intent is to give some specific examples of the extent to which agricultural development would positively or negatively change the capability of a region to produce wildlife. Related to this is a discussion of effects on habitat quality by administrative region.

Calculated changes in productive capability are briefly discussed in relation to the "Status of the Fish and Wildlife Resource in Alberta" (Energy and Natural Resources 1984b). These discussions evaluate altered capability relative to production required to satisfy future consumptive and non-consumptive demand for fish and wildlife resources.

Species selected for examination were chosen with respect to several criteria. First, sufficient information had to be available on the productive capability of various regions of the province. Second,

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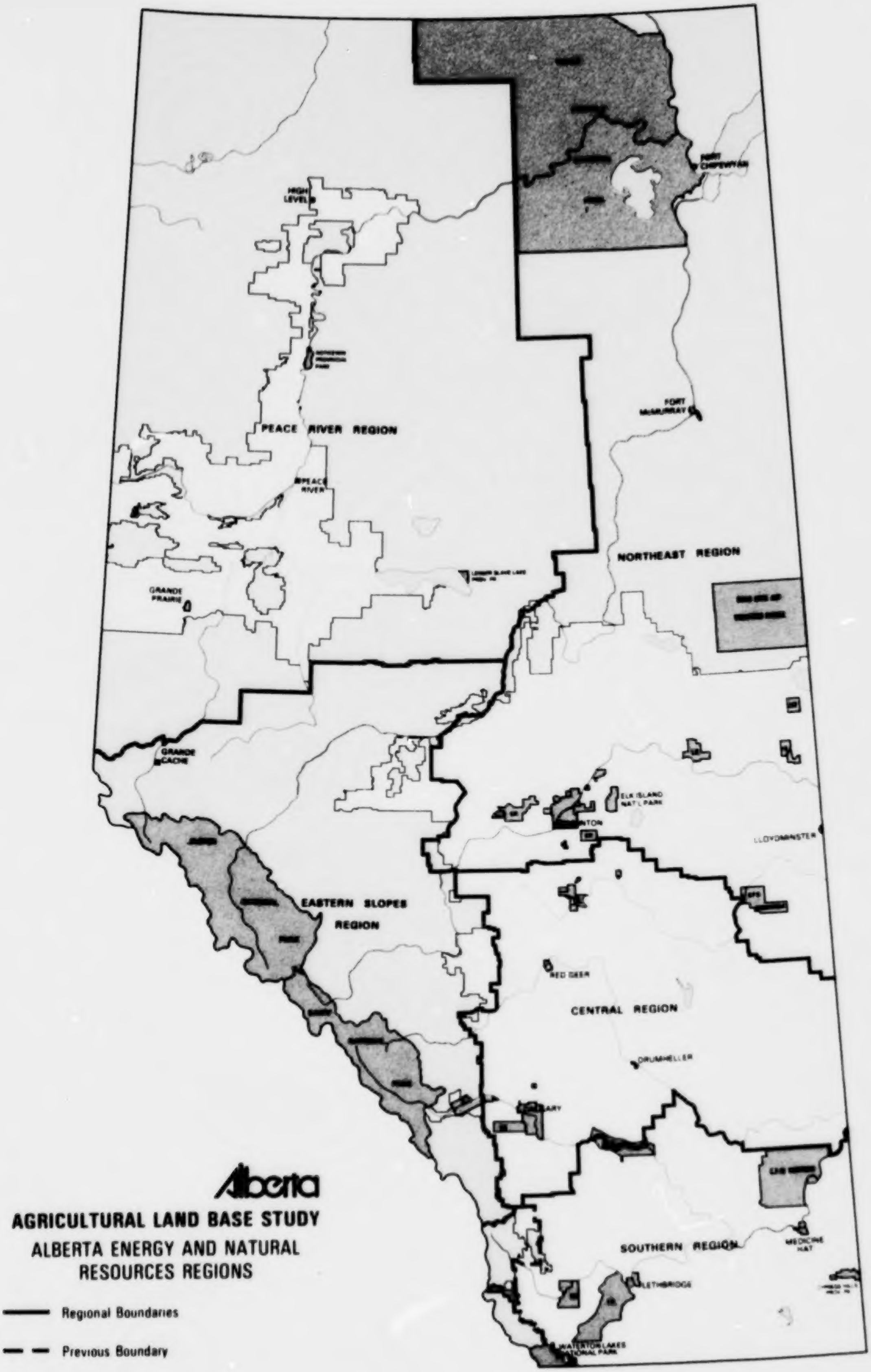
[1] A change was made in the boundary between the Southern and Eastern Slopes Regions in the Spring of 1985. The analyses conducted for the fish and wildlife resources used the pre-1985 boundary shown in Figure 5.

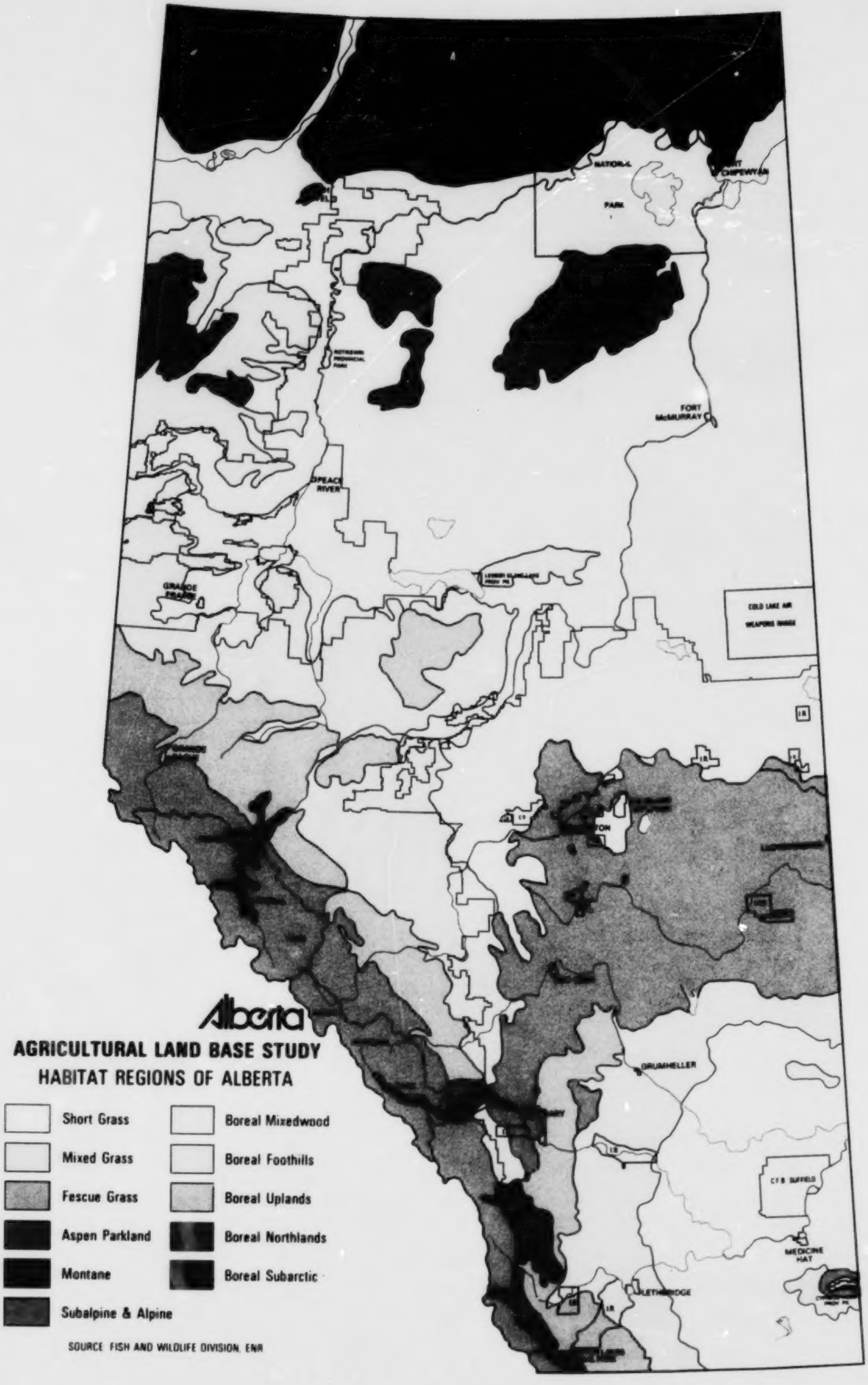


HIGH LEVEL
FORT CHIPEWYAN
PEACE RIVER REGION
PEACE RIVER
FORT McMURRAY
NORTHEAST REGION
GRANDE PRAIRIE
GRANDE CACHE
ELK ISLAND NAT'L PARK
LLOYDMINSTER
EASTERN SLOPES REGION
RED DEER
CENTRAL REGION
DRUMHELLER
SOUTHERN REGION
MEDICINE HAT
LETHBRIDGE
WATERTON LAKES NATIONAL PARK
Alberta
Regional Boundaries
Previous Boundary

AGRICULTURAL LAND BASE STUDY

ALBERTA ENERGY AND NATURAL RESOURCES REGIONS

PRODUCED BY THE RESOURCE EVALUATION AND PLANNING DIVISION, ALBERTA ENERGY AND NATURAL RESOURCES, 1985

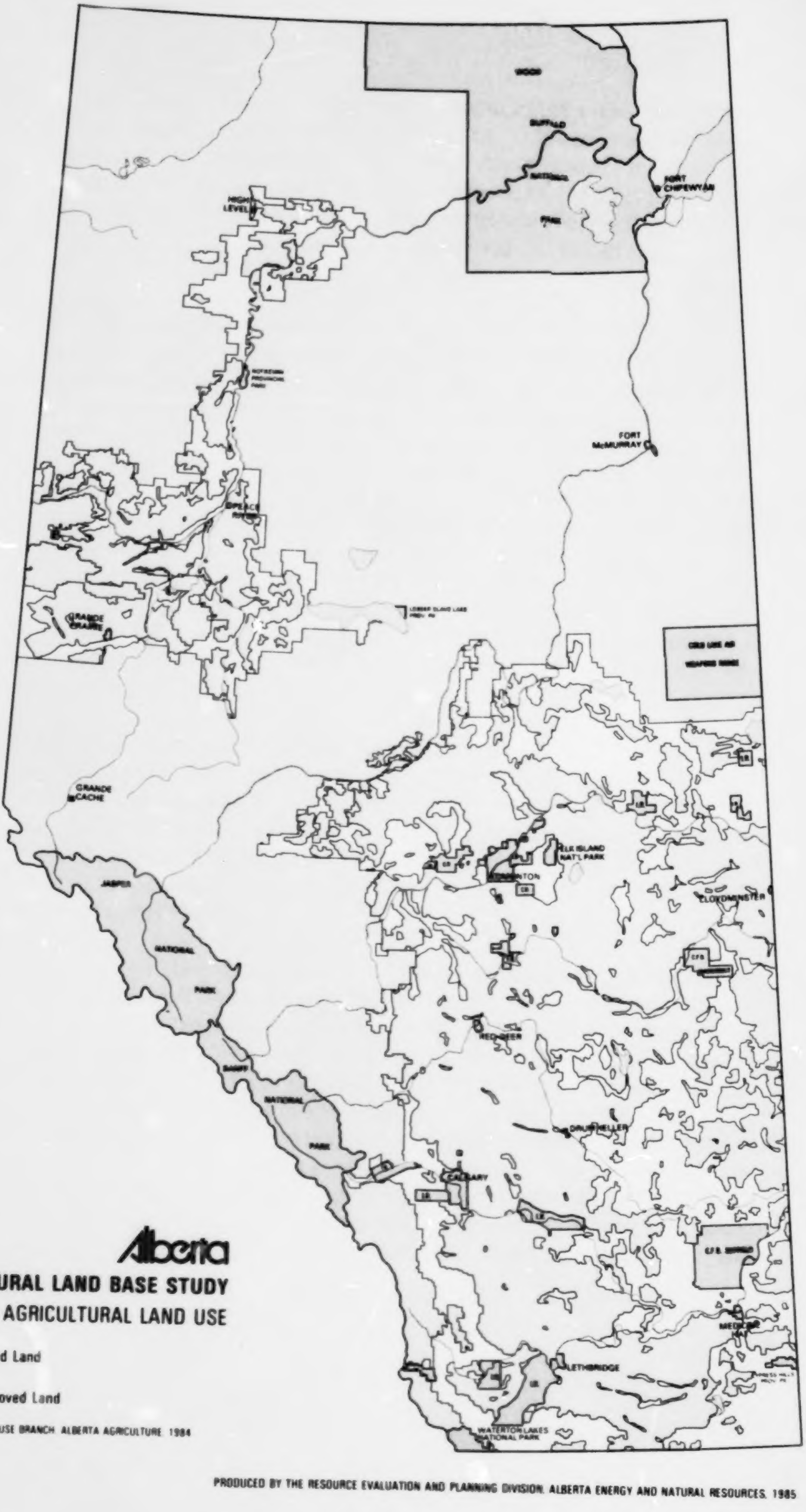

Alberta
NATIONAL PARK
FORT CHIPEWYAN
FORT McMURRAY
PEACE RIVER
GRANDE PRAIRIE
COLD LAKE AIR WEAPONS RANGE
DRUMHELLER
CFB SUFFIELD
MEDICINE HAT
LETHBRIDGE
Short Grass
Mixed Grass
Fescue Grass
Aspen Parkland
Montane
Subalpine & Alpine
Boreal Mixedwood
Boreal Foothills
Boreal Uplands
Boreal Northlands
Boreal Subarctic

AGRICULTURAL LAND BASE STUDY

HABITAT REGIONS OF ALBERTA

SOURCE: FISH AND WILDLIFE DIVISION, ENR

PRODUCED BY THE RESOURCE EVALUATION AND PLANNING DIVISION, ALBERTA ENERGY AND NATURAL RESOURCES, 1985


WOOD
BUFFALO
NATIONAL
PARK
FORT CHIPEWYAN
HIGH LEVEL
FORT McMURRAY
PEACE RIVER
GRANDE PRAIRIE
LESSER SLAVE LAKE PROV. PK
COLD LAKE AIR WEAPONS RANGE
GRANDE CACHE
ELK ISLAND NAT'L PARK
EDMONTON
LLOYDMINSTER
JASPER
NATIONAL
PARK
RED DEER
BANFF
NATIONAL
PARK
DRUMHELLER
CALGARY
IR
CFB
C.F.B. SUFFIELD
MEDICINE HAT
LETHBRIDGE
WATERTON LAKES NATIONAL PARK

Alberta

AGRICULTURAL LAND BASE STUDY
DOMINANT AGRICULTURAL LAND USE

▨ Improved Land

☐ Umimproved Land

SOURCE LAND USE BRANCH ALBERTA AGRICULTURE 1984

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species had to have an obvious economic importance within the province. In some cases "indicator" species were dealt with. These species were especially representative of species dependent on a specific type of habitat. It should be noted that the consequences of agricultural development will not be limited to species selected for examination. In some instances specific analyses are provided with given alternatives to answer appropriate questions.

The major information source used in the analyses was the Preliminary Wildlife Habitat Region/Sub-region Map of Alberta (Energy and Natural Resources 1984a) at 1:1 million. This map was overlayed on the 1:1 million maps supplied for each agricultural alternative being considered. The Wildlife Habitat Region/Subregion Map divides the province into 12 regions (Figure 3), essentially broad climatic ecoregions, and 278 sub-regions, based on physiographic/landform features. A legend describes the biophysical features of each sub-region. Information is available on the potential capability of each sub-region for the production of a series of wildlife species. Potential capability is essentially the long term average potential to produce a given species. In any one year the actual number of animals in a sub-region may be greater or less than the potential capability of the area.

The effect of each agricultural development alternative on the current non-agricultural land base was established by first measuring the amount of non-agricultural land, as given on the Agricultural Current Use Map (Figure 4), in each sub-region, habitat region and each administrative region. The potential area affected by each alternative was then similarly measured and expressed as a percentage of the total current non-agricultural land.

The impact that the development of non-agricultural land could have on wildlife in general was estimated by first preparing a list of all bird and mammal species found in each habitat region of the province. Each species, found in a habitat region where some agricultural development could occur, was then evaluated as to whether or not development would constitute a negative impact. These estimates were summarized and considered in a general discussion along with the documented potential impacts on non-agricultural land. In general, no attempt was made to determine how many species could be positively impacted as a result of a given development alternative since in many cases an analysis of positive impacts would be based on a series of rather tenuous assumptions.

All species considered in the above analysis were lumped into one of four groups. These groups include mammal species, breeding bird species, resident non-breeding bird species and migrant bird species. Breeding bird species are species which are known to breed in at least a portion of a given habitat region. Resident non-breeding birds are species which are summer or winter residents of a habitat region but do not breed in that region. The snowy owl for instance would be classed as a winter non-breeding resident species in the aspen parkland. Migrant birds are species which migrate through Alberta but do not reside here except during their migration. The snow goose would be classed as a migrant species in several habitat regions of the province.

The consequences of an agricultural development alternative on the potential to produce a given species within an administrative region was established on the basis of the habitat sub-regions. To do this, vegetative cover and land surface disturbance following new agricultural development were estimated for each affected sub-region. This was accomplished by determining the area of potential new agricultural land and subtracting that area from the current area of the appropriate category of unimproved land. Once the physiographic and vegetative characteristics of the sub-region were reworked to reflect a "post-development" condition then an attempt was made to find the nearest sub-region which currently is in a condition similar to the projected condition of the sub-region in question. Once a match was made, the current wildlife capability information available for this "most similar" sub-region was considered characteristic of the sub-region in question following development. Changes in capability for the various sub-regions were summarized for each administrative region. This method is based on the assumption that the capability to produce wildlife in an area following agricultural development would be similar to the capability of adjacent areas which have already experienced a similar degree of improvement for agriculture. This technique acknowledges that in some cases wildlife production on non-agricultural lands can be influenced by the proximity of new agricultural development.

The above method was applied to five of the six agricultural development alternatives being considered, with some occasional minor modifications. The exception is the Drainage alternative which is based on original work conducted as part of the drainage inventory study. Methods employed for analyses specific to certain alternatives are discussed adjacent to the results of the given alternative.

3.2 Timber Resources

There are three agricultural alternatives that could have important effects on timber resources. These are Green Area Conversion, Range Improvement and Woodland Conversion. Assessments of these impacts were conducted by the Alberta Forest Service, Forestry, Lands and Wildlife.

The determination of possible consequences for the timber resource from the Green Area Conversion alternative was based on the map delimiting potentially arable land in the Green Area. Each township in the Green Area containing potentially arable land was identified and the proportion of potentially arable land estimated. A timber inventory for each of these townships was then generated by AFORISM, the computerized timber inventory system maintained by the Alberta Forest Service. The AFORISM report provided timber volumes for each township, which were then adjusted by the proportion actually considered potentially arable. These modified volumes were aggregated by Forest Management Unit (FMU) and expressed as a percentage of the total for each FMU. These were then reduced by 15 percent which is the amount of potentially arable land considered unavailable for expansion by Public Lands, and which was used to determine that 9.2 million acres of the Green Area could be suitable for field crops. The final volume figure represents the percentage of the FMU volume lost under maximum agricultural expansion. These values were also totalled for each forest and Forest Management Agreement Area. The potential area lost from timber management was calculated in a similar manner through AFORISM.

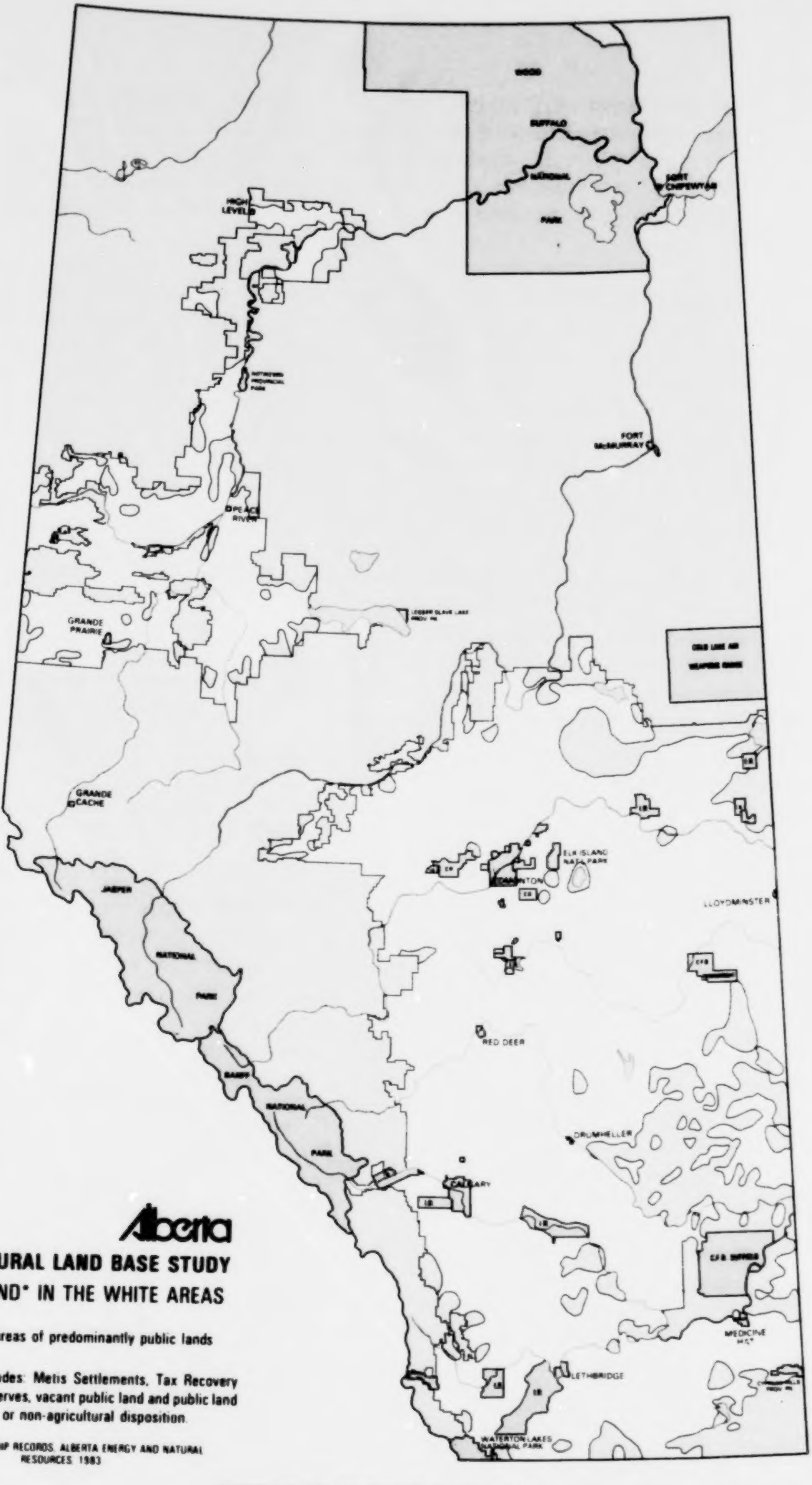
Reductions in the annual allowable cut (AAC) resulting from agricultural expansion were also calculated. AAC is the total amount of timber by volume that may be harvested in one year based on sustained yield. AAC figures are normally calculated for each FMU as a whole. It is difficult to estimate the AAC for an area smaller than an FMU, so the proportion of area of timber lost was used as an estimate of the AAC lost. Further, a sample survey over a portion of the land base indicated that the entire area was not of equal productivity. Therefore, a factor was calculated indicating the relative proportion of high versus medium and low productivity land. This factor was then applied to the area removed from each FMU and this modified area figure was used in the determination of the final AAC figure. This final figure represents the proportion of the AAC lost from each FMU . The amount of timber that has been committed by the Province to timber companies, and which could be affected by expansion into the Green Area was also identified.

The Alberta Forest Service is developing a number of Community Farm Woodlots (CFWs) throughout the province. These are small to medium sized forested areas in the White Area set aside to provide timber for local community use. Range Improvement and Woodland Conversion could have a major impact on the CFW program if these areas are removed. To determine the impact, a map of the location of all proposed and existing CFWs was compared to the maps indicating the areas capable for Range Improvement and Woodland Conversion. It was assumed that all areas capable for these options would be completely removed from the CFW land base. Using this assumption, the percentage of area removed from each CFW was estimated visually. Timber volumes for each CFW are not available, so the analysis was confined to area estimates.

3.3 Public Rangeland Resources

Public land in the White Area (Figure 5) is leased for grazing, cultivation, recreational, commercial and industrial uses, and includes Tax Recovery Land. A number of alternatives could impact grazing on public land in the White Area. For the purpose of this study these public rangelands are considered to be a separate and important resource, not simply as a less intense or more extensive agricultural resource use. Only very small amounts of public land are disposed for cultivation in the White Area, and in most cases these dispositions lead to title so they can be considered private land for the purpose of this study. The Irrigation Expansion, Range Improvement, Prairie Range Conversion and Woodland Conversion alternatives could affect grazing on public land in the White Area. Effects were assessed by the Public Lands Division, Forestry, Lands and Wildlife. In addition the Green Area Conversion alternative would impact grazing in the Green Area. The Alberta Forest Service assessed these effects.

The analysis of projected consequences in the White Area was based on the overlaying of 1:1 million maps. The maps used were: non-cultivated CLI class 1-4 soils in the White Area; CLI class 5 soils (with solonetzic, saline and acid soils removed); potentially irrigable land; all sections of Crown land having 2 or more quarters affected by grazing dispositions (Grazing Lease, Grazing Permit or Hay Permit); and a map of Grazing Reserves. The CLI arable land map and irrigation land map were overlayed on the grazing disposition map to identify public land where range or woodland may be converted to dryland or irrigated field crop production. Similarly the CLI range improvement map, with excluded soils, was overlayed on the grazing disposition map to define


WOOD
BUFFALO
NATIONAL
PARK
FORT CHIPEWYAN
HIGH LEVEL
PEACE RIVER
LESSER SLAVE LAKE PROV. PK
FORT McMURRAY
GRANDE PRAIRIE
COLD LAKE AIR WEAPONS RANGE
GRANDE CACHE
ELK ISLAND NAT'L PARK
EDMONTON
GR
LLOYDMINSTER
CFB
JASPER
NATIONAL
PARK
RED DEER
BANFF
NATIONAL
PARK
DRUMHELLER
CALGARY
GR
CFB SUFFIELD
MEDICINE HAT
LETHBRIDGE
WATERTON LAKES NATIONAL PARK
PROV. PK

Alberta

AGRICULTURAL LAND BASE STUDY

PUBLIC LAND* IN THE WHITE AREAS

☐ Major areas of predominantly public lands

*Public land includes: Metis Settlements, Tax Recovery Land, Grazing Reserves, vacant public land and public land under agricultural or non-agricultural disposition.

SOURCE: TOWNSHIP RECORDS, ALBERTA ENERGY AND NATURAL RESOURCES 1983

PRODUCED BY THE RESOURCE EVALUATION AND PLANNING DIVISION, ALBERTA ENERGY AND NATURAL RESOURCES, 1985

public land that could be improved for grazing. The resulting maps showing areas of impact on public grazing were cross-examined using Public Lands Division field information and average carrying capacities in the various regions. Field knowledge and information were used wherever possible to define acreages, arable potential and improvement potential.

Impacts are described in terms of lost animal unit months (AUMs) and totals are provided for administrative regions (Figure 2). The average grazing season was assumed to be 5 months. Prairie Range Improvement carrying capacity in the Brown Soil Zone is 0.2 AUMs/acre; 0.35 AUMs/acre in the Dark Brown Soil Zone; and 0.5 AUMs/acre in the Black Soil Zone. Woodland Range Improvement carrying capacity in the Black Soil Zone is 0.25 AUMs/acre; Gray (Central) Soil Zone is 0.2 AUMs/acre; and Gray (Peace) Soil Zone is 0.2 AUMs/acre.

The effects on grazing in the Green Area were assessed by identifying grazing dispositions that overlap with potentially arable land. The proportion of each disposition that could be affected was then determined and applied to AUMs for each disposition. These totals were then reduced by 15 percent which is the amount generally held back from disposition (see Agriculture Inventory Report) and aggregated for each Forest.

3.4 Recreation Resources

The Alberta Forest Service assessed impacts of the Green Area Conversion alternative on recreation sites in the Green Area. All existing and proposed recreation sites were overlayed with the Green Area Conversion map and affected sites identified.

Other recreation impacts are discussed under related resource sectors such as water resources.

3.5 Soil Resources

Soil erosion by wind and water is a continuing and persistent problem on agricultural lands. Four agricultural development alternatives could affect Alberta's soil resources. These are: Summerfallow Reduction, Prairie Range Conversion, Green Area Conversion and Woodland Conversion. Wind and water erosion are viewed as serious regional problems. Wind erosion is viewed as a major problem in the southeast whereas water erosion has been a major problem in the northwest and is a potential problem in the remainder of the province. The assessment of wind erosion impacts were conducted by Alberta Agriculture while water erosion impacts were assessed by Alberta Environment.

The American Natural Resources Inventory (United States 1977) estimates two-thirds of total erosion losses are by water, one-third by wind. In Alberta erosion is a continuing and persistent problem on agricultural land. Wind erosion has been more widely devastating on the prairies, whereas water erosion is less noticeable although still a serious problem. Information is available to outline expected consequences of potential agricultural developments. Methods of measuring erosion are expensive and time consuming, therefore the results of most studies have been of a qualitative nature as little or no quantitative data exists. No provincial monitoring system is currently in place with the result that impacts summarized in this study are based on literature reviews and experience with erosion in Alberta.

3.6 Water Resources

A total of six agricultural options could have important effects on water resources. These effects were assessed for Green Land Conversion, Irrigation Expansion, Range Improvement, Prairie Range Conversion, Woodland Conversion and Saline Soils Reclamation. The assessments were conducted by the Planning Division, Alberta Environment.

The agricultural use of land has been identified as one of the major causes of water quality degradation and streamflow changes in the more intensively farmed areas of North America. The clearing and cultivation of land leads to: changes in natural drainage and streamflows; the erosion of soil; the pollution of water with sediment, nutrients and agricultural chemicals; and the depletion of water supplies through withdrawals from streams and lakes for agricultural uses. These effects have been observed in Alberta with at times conflicting opinions as to their extent and severity. It is very difficult to accurately pinpoint the causes of the changes and to separate them from naturally occurring processes, however, these effects have been observed and studied frequently enough to be considered predictable outcomes of agricultural land use.

Assessing these impacts in any quantitative sense is almost impossible at the scale of the ALBS, however the general location of possible effects and a subjective ranking of their severity can be made based on previous experience and research in this area. Data sources include test plots measuring runoff and erosion rates from cropped land, models predicting nutrient and sediment loss from agricultural land, soil erodibility maps, and general information on soils, topography, drainage patterns, and climatic factors. Considerable information is also available on the impacts of irrigation expansion and the reclamation of saline soils from the South Saskatchewan River Basin Planning Program (Alberta Environment 1985a) and research on irrigated lands conducted in southern Alberta (e.g. Harker 1980).

Using these sources it is possible to predict some of the potential impacts on Alberta's rivers and lakes of expanding and intensifying agricultural land use. In particular, areas of high susceptibility to erosion, or watercourses vulnerable to increased sediment and nutrient loading can be identified and the potential for damage outlined in Alberta.

4. GREEN AREA CONVERSION

The Green Area consists of public land withdrawn from settlement, and covers approximately 51 per cent of Alberta's total area. This land is primarily managed for forest production, watershed protection, recreation and other multiple uses. If suitable, public land may be made available for agricultural disposition. There are approximately 10.8 million acres of potentially arable land, (CLI class 1-4), predominantly located in the northwest portion of the Green Area. Public Lands Division information indicates that where no other resource concerns exist, approximately 15 per cent of new land is not posted due to physical landscape limitations. Therefore, it is estimated that 9.2 million acres could be brought into agricultural crop production (see Figure 6).

4.1 Fish and Wildlife Resources

4.1.1 Reduction of the Non-Agricultural Land Base

Tables 4.1 and 4.2 describe the extent to which expansion would affect current non-agricultural land within the province. It is evident that the major portion of expansion would take place in the Peace River administrative region (Table 4.1). Approximately 18 percent of all non-agricultural land in this region would be taken up by expansion. Lesser amounts of development would occur in the Eastern Slopes and Northeast regions. Green Area Conversion would affect 10 percent of all non-agricultural land in the province. A significant portion of two habitat regions would be influenced by expansion (Table 4.2). Fifteen per cent of current non-agricultural Boreal Mixedwood habitat and 22 per cent of non-agricultural Boreal Foothills habitat would go to agricultural uses. Species using these two habitat regions would be affected most by agricultural expansion.

Table 4.1

POTENTIAL REDUCTION OF NON-AGRICULTURAL OR UNIMPROVED LAND THROUGH GREEN AREA CONVERSION BY ADMINISTRATIVE REGION

Administrative Region	Potential Area Affected (000 acres)	Potential Development as % of Non Agricultural or Predominently Unimproved Land in each region
Southern	--	--
Central	--	--
Eastern Slopes	1 400	8
Peace River	8 702	18
Northeast	698	3
Provincial Total	10 800[1]	10

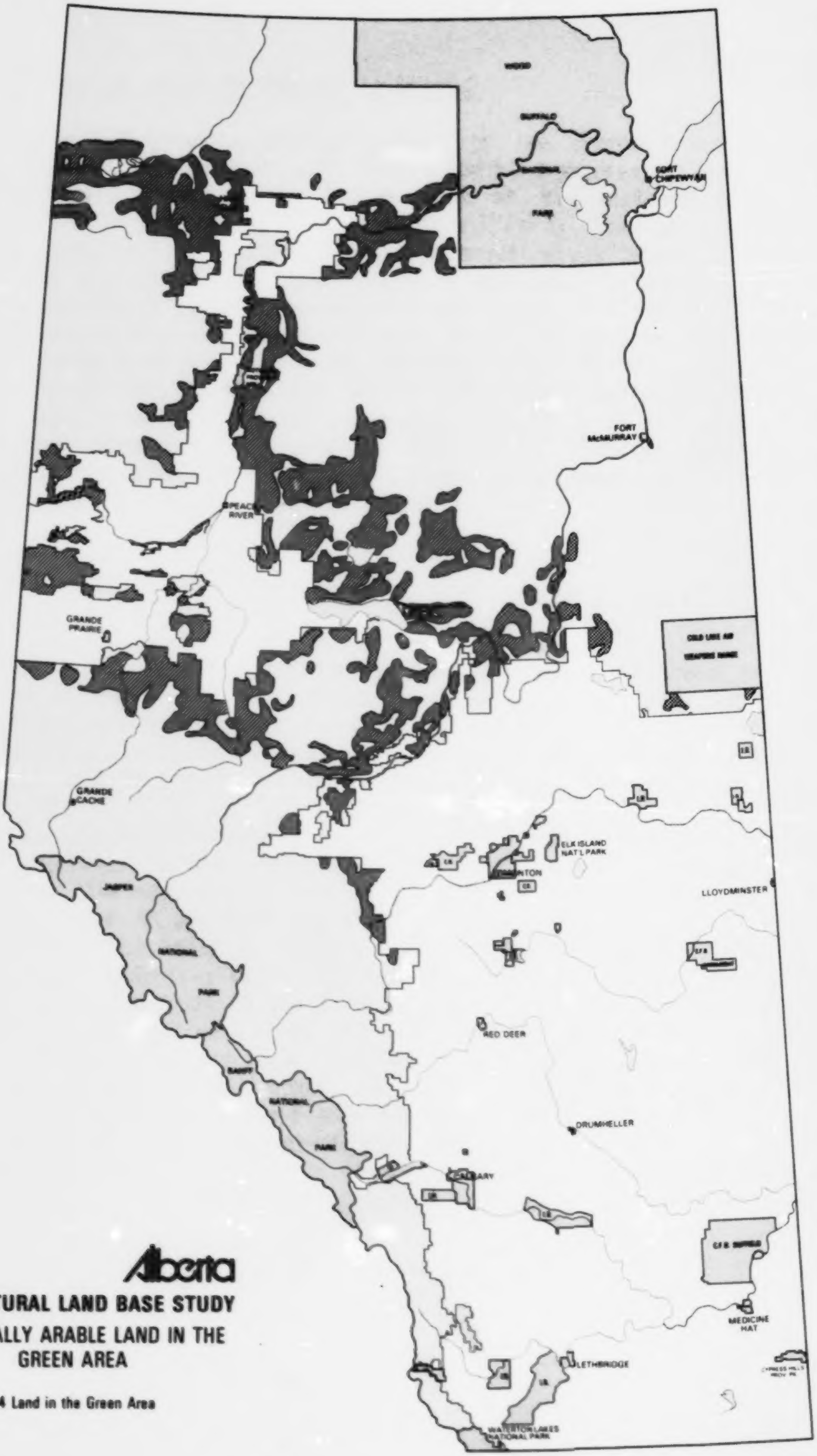
[1]. It should be noted that in the preparation of Tables 4.1 and 4.2, 10.8 million acres of potential development was used instead of 9.2 since the 15 per cent of land held back would be altered significantly in its ability to support wildlife.

Table 4.2

POTENTIAL REDUCTION OF NON-AGRICULTURAL OR UNIMPROVED LAND THROUGH GREEN AREA CONVERSION BY HABITAT REGION

Habitat Region	Potential Area Affected (000 acres)	Potential Development as % of Non Agricultural or Predominently Unimproved Land in each region
Shortgrass Prairie	--	--
Mixed Grass Prairie	--	--
Fescue Grassland	--	--
Aspen Parkland	--	--
Montane	--	--
Subalpine	--	--
Alpine	--	--
Boreal Mixedwood	6 864	15
Boreal Foothills	3 527	22
Boreal Uplands	186	2
Boreal Northlands	224	2
Boreal Subarctic	--	--
Provincial Total	10 800[1]	10

[1]. Footnote - see footnote for Table 4.1


WOOD
BUFFALO
NATIONAL
PARK
FORT CHIPEWYAN
FORT McMURRAY
PEACE RIVER
GRANDE PRAIRIE
COLD LAKE AIR WEAPONS RANGE
GRANDE CACHE
ELK ISLAND NAT'L PARK
EDMONTON
LLOYDMINSTER
JASPER
NATIONAL
PARK
RED DEER
BANFF
NATIONAL
PARK
DRUMHELLER
CALGARY
C.F.B. SUFFIELD
MEDICINE HAT
LETHBRIDGE
CYPRESS HILLS PROV. PK.
WATERTON LAKES NATIONAL PARK

Alberta

AGRICULTURAL LAND BASE STUDY

POTENTIALLY ARABLE LAND IN THE GREEN AREA

▨ CLI 1-4 Land in the Green Area

PRODUCED BY THE RESOURCE EVALUATION AND PLANNING DIVISION, ALBERTA ENERGY AND NATURAL RESOURCES, 1985

4.1.2 Impacts on Wildlife Species in General

Table 4.3 gives a general summary of the effect Green Area Conversion would have on individual mammal and bird species. Expansion would negatively impact 69 to 74 per cent of the resident mammal species living in four boreal habitat regions. Forty three per cent of all mammal species in the province would be negatively affected to some degree. Of the 35 species that would be affected, 19 species are currently subject to licensed consumptive use in the province, and each of the 35 species has some non-consumptive value. Forty three per cent of all breeding bird species in the province would realize some negative impact. Eight of these 105 species are subject to licensed consumptive use. A negative impact would occur for 52 to 56 per cent of all breeding bird species found in four boreal habitat regions. Agricultural expansion would have a relatively small impact on resident non-breeding bird species and migrant bird species.

4.1.3 Impacts on the Potential to Produce a Series of Wildlife Species

Table 4.4 presents information on the effects of Green Area Conversion on the provincial potential to produce moose, elk, whitetail deer and mule deer. An analysis of how expansion would alter the amount of land in given habitat suitability classes is also given (Tables 4.5 to 4.8) for these species.

Green Area Conversion would result in a marked reduction (23 per cent decline) in the provincial capability for moose production (Table 4.4). The majority of loss would occur in the Peace River (38 per cent decline in regional capability) and Eastern Slopes (22 per cent decline) administrative regions. Expansion would greatly reduce the amount of productive moose habitat in Alberta (Table 4.5). The amount of class 1 habitat in the Eastern Slopes and Peace River Regions would decline considerably (-40 per cent and -71 per cent respectively). There would also be a large decrease in class 2 land in the Peace River Region (-30 per cent). A decline in the availability of productive moose habitat would hinder future utilization of the remaining moose populations. Hunter success rates, for instance, would likely decline if hunting activity is forced to shift to non-productive habitats with resident moose populations at very low densities.

Table 4.3

MAMMAL AND BIRD SPECIES NEGATIVELY IMPACTED BY GREEN AREA CONVERSION*

Habitat Region	Mammal Species	Breeding Bird Species	Resident Non-Breeding Bird Species	Migrant Bird Species
Boreal Mixedwood	32/45 = 71%	93/179 = 52%	1/7 = 14%	1/24 = 4%
Boreal Foothills	31/45 = 69%	78/143 = 55%	--	1/5 = 20%
Boreal Uplands	32/46 = 70%	80/143 = 56%	--	1/2 = 50%
Boreal Northlands	28/38 = 74%	77/144 = 53%	1/6 = 17%	1/25 = 4%
All Others	--	--	--	--
Provincial Total	35/82 = 43%	105/245 = 43%	1/13** = 8%	1/25 = 4%

* Many individual species occur in more than one habitat region.

** Eight Resident non-breeding bird species are also counted as breeding bird species in other regions of the province.

Table 4.4

IMPACTS OF GREEN AREA CONVERSION
ON THE CAPABILITY TO PRODUCE SELECTED UNGULATES

Net number of animals lost or gained and percentage change in total current potential capability.

ADMINISTRATIVE REGIONS						
	SOUTHERN	CENTRAL	EASTERN SLOPES	PEACE RIVER	NORTH-EAST	PROVINCIAL TOTAL
MOOSE	0 (--)	0 (--)	-9 700 (-22%)	-27 000 (-38%)	-1 900 (-4%)	-38 600 (-23%)
ELK	0 (--)	0 (--)	-500 (-2%)	-1 200 (-26%)	-100 (-18%)	-1 800 (-6%)
WHITE-TAILED DEER	0 (--)	0 (--)	+2 500 (+24%)	+5 300 (+43%)	+1 700 (+3%)	+9 500 (+8%)
MULE DEER	0 (--)	0 (--)	-800 (-2%)	-6 600 (-29%)	-800 (+3%)	-8 200 (-6%)

Table 4.5

IMPACTS OF GREEN AREA CONVERSION ON MOOSE HABITAT

Net change in the amount of available habitat (000 acres) and percentage change relative to total current habitat.

	ADMINISTRATIVE REGIONS					
HABITAT SUITABILITY CLASS	SOUTHERN	CENTRAL	EASTERN SLOPES	PEACE RIVER	NORTH-EAST	PROVINCIAL TOTAL
1 (4.9 moose/1000 acres)	0 (--)	0 (--)	-2 200 (-40%)	-2 984 (-71%)	-126 (-4%)	-5 311 (-39%)
2 (1.6 moose/1000 acres)	0 (--)	0 (--)	+511 (+5%)	-8 402 (-30%)	-852 (-5%)	-8 743 (-16%)
3 (0.4 moose/1000 acres)	0 (--)	0 (--)	+292 (+9%)	+2 755 (+17%)	+281 (+2%)	+3 329 (+10%)
4 (0 moose/1000 acres)	0 (--)	0 (--)	+1 396 (+1 708%)	+8 362 (+137%)	+696 (+8%)	+10 724 (+25%)

Expansion would produce a slight decline (-6 per cent) in the provincial capability for elk production (Table 4.4). In terms of regional capability, however, a signficant decline would occur in the Peace River Region (-26 per cent). Similarly, a significant reduction would occur in the amount of quality habitat currently available in the Peace River Region (Table 4.6).

A slight increase (8 per cent) in the provincial capability for white-tailed deer production would occur with expansion (Table 4.4). This overall increase would come largely from regional increases in Peace River (43 per cent) and the Eastern Slopes (24 per cent). Both of these regions currently have a relatively small capability for whitetailed deer production. Habitat of good quality for white-tailed deer would be created in the Eastern Slopes while only moderate quality habitat would be created in Peace River (Table 4.7). It should be noted that these potential increases in white-tailed deer populations will only be realized during extended periods of favourable climate. Provincial experts believe that white-tailed deer populations in northern Alberta are currently limited by climatic factors rather than by habitat availability.

The provincial capability for mule deer production would decline slightly (-6 per cent decline) with expansion (Table 4.4). The major portion of the decline would occur in the Peace River Region and this decrease would considerably reduce the region's capability (-29 per cent). More than one half (-58 per cent) of the best habitat currently available in Peace River would be lost (Table 4.8).

As indicated in Table 4.9, agricultural exansion would make it difficult to achieve the provincial population goals for moose, elk and mule deer. Effects would be most severe for moose. While expansion would aid in achieving the white-tailed deer population goal.

4.1.4 Consequences for Certain Vulnerable Wildlife Species

Table 4.10 gives a general analysis of how expansion would affect grizzly bear and caribou. This table was compiled by first summarizing the total area of all habitat regions for each administrative region, where grizzly bear or caribou are currently found. Each sub-region was then examined for agricultural expansion potential. The total area of all subregions with some expansion potential was summarized as above. This analysis is based on the assumption that the quality of the habitat present in each sub-region would decline markedly following any agricultural development. Both grizzly bear and caribou have a demonstrated sensitivity to even small amounts of agricultural development (Nietfeld, et al. 1984).

Table 4.6

IMPACTS OF GREEN AREA CONVERSION ON ELK HABITAT

Net change in the amount of available habitat (000 acres) and percentage change relative to total current habitat.

	ADMINISTRATIVE REGIONS					
HABITAT SUITABILITY CLASS	SOUTHERN	CENTRAL	EASTERN SLOPES	PEACE RIVER	NORTH-EAST	PROVINCIAL TOTAL
1 (3.2 elk/1000 acres)	0 (--)	0 (--)	0 (--)	0 (--)	0 (--)	0 (--)
2 (0.8 elk/1000 acres)	0 (--)	0 (--)	-482 (-5%)	-1 129 (-41%)	-38 (-11%)	-1 650 (-11%)
3 (.08 elk/1000 acres)	0 (--)	0 (--)	-1 386 (-41%)	+3 350 (-27%)	-1 430 (-21%)	-6 165 (-26%)
4 (0 elk/1000 acres)	0 (--)	0 (--)	+1 867 (+113%)	+4 179 (+12%)	+1 468 (+5%)	+7 815 (+8%)

Table 4.7

IMPACTS OF GREEN AREA CONVERSION ON WHITE-TAILED DEER HABITAT

Net change in the amount of available habitat (000 acres) and percentage change relative to total current habitat.

ADMINISTRATIVE REGIONS						
HABITAT SUITABILITY CLASS	SOUTHERN	CENTRAL	EASTERN SLOPES	PEACE RIVER	NORTH-EAST	PROVINCIAL TOTAL
1 (4.0 deer/ 1000 acres)	0 (--)	0 (--)	+1 359 (+1 647%)	0 (--)	+42 (< +1%)	+4 000 (+10%)
2 (1.6 deer/ 1000 acres)	0 (--)	0 (--)	-1 359 (-46%)	+3 401 (+228%)	+1 269 (+19%)	+3 313 (+17%)
3 (0.4 deer/ 1000 acres)	0 (--)	0 (--)	0 (--)	-414 (-2%)	-1 310 (-11%)	-1 724 (-3%)
4 (0 deer/1000 acres)	0 (--)	0 (--)	0 (--)	-2 987 (-11%)	-2 (< -1%)	-2 989 (-7%)

Table 4.8

IMPACTS OF GREEN AREA CONVERSION ON MULE DEER HABITAT

Net change in the amount of available habitat (000 acres) and percentage change relative to total current habitat.

	ADMINISTRATIVE REGIONS					
HABITAT SUITABILITY CLASS	SOUTHERN	CENTRAL	EASTERN SLOPES	PEACE RIVER	NORTH-EAST	PROVINCIAL TOTAL
1 (4.9 deer/1000 acres)	0 (--)	0 (--)	-14 (-1%)	0 (--)	-18 (-1%)	-32 (< -1%)
2 (1.6 deer/1000 acres)	0 (--)	0 (--)	-456 (-3%)	-4 076 (-58%)	-199 (-2%)	-4 732 (-11%)
3 (0.4 deer/1000 acres)	0 (--)	0 (--)	+113 (+5%)	+58 (< +1%)	-1 072 (-5%)	-901 (-1%)
4 (0 deer/1000 acres)	0 (--)	0 (--)	+358 increase is from 0	+4 018 (+22%)	+1 290 (+17%)	+5 666 (+22%)

Table 4.9

IMPACTS OF GREEN AREA CONVERSION ON PROVINCIAL POPULATIONS OF SELECTED UNGULATES, IN RELATION TO THE "FISH AND WILDLIFE STATUS REPORT".

MOOSE:

Current Actual Population = 118 000
Actual Population Following Expansion = 90 700
Status Report Goal = 150 000

ELK:

Current Actual Population = 15 000
Actual Population Following Expansion = 14 200
Status Report Goal = 30 000

WHITE-TAILED DEER:

Current Actual Population = 118 000
Actual Population Following Expansion = 124 000
Status Report Goal = 125 000

MULE DEER:

Current Actual Population = 73 000
Actual Population Following Expansion = 68 500
Status Report Goal = 100 000

Footnote: Below is an example of how these numbers have been calculated.

$$\frac{118\ 000 \text{ (current actual moose population)}}{168\ 223 \text{ (current potential moose population)}} \text{ X } 100 = 70\% \text{ (\% of potential achieved)}$$

Potential following Green Area expansion = 168 223 - 38 613 = 129 610 moose.

Actual number of moose following expansion = 129 610 X 0.7 = 90 727 moose.

The status report goal is 150 000 moose.

Table 4.10

IMPACTS OF GREEN AREA CONVERSION ON GRIZZLY BEAR AND CARIBOU HABITAT

(000 acres)

		ADMINISTRATIVE REGIONS					
		SOUTHERN	CENTRAL	EASTERN SLOPES	PEACE RIVER	NORTH-EAST	PROVINCIAL TOTAL
Total area of habitat subregions where species are present.	GRIZZLY BEAR	284	92	17 243	16 044	3 539	37 202
	CARIBOU	--	--	3 926	36 283	17 817	57 833
Total area of habitat subregions potentially affected by agricultural expansion	GRIZZLY BEAR	--	17	6 163	14 706	3 413	24 298
	CARIBOU	--	--	1 601	26 843	8 513	36 958
Percentage of current habitat affected	GRIZZLY BEAR	--	19	35	92	96	65
	CARIBOU	--	--	41	74	48	64

Expansion would eventually result in the loss of viable grizzly populations on 65 per cent of their current occupied range within the province. Regional populations in the Peace River (-92 per cent) and Northeast (-96 per cent) regions would be severely reduced. Sixty four per cent of current caribou range within the province would eventually be affected.

4.1.5 Registered Traplines

The extent to which Green Area Conversion would influence registered traplines was established by overlaying the expansion map onto a map showing all traplines in the province. The area of expansion potential was then measured within each trapline and summarized for all traplines in each administrative region. It was assumed that individual traplines would normally be abandoned if 40 per cent or more of their area was given over to agricultural uses.

Approximately 10 per cent of the total area of registered traplines in Alberta would be lost with maximum expansion (Table 4.12). Of the total number of traplines in the province, about 35 per cent would be affected to some degree and 15 per cent would be lost entirely. Regionally the greatest effects would be in the Peace River Region where 51 per cent of all registered traplines would be affected to some degree and 24 per cent lost entirely.

4.1.6 Fisheries

Green Area Conversion would have some serious negative affects on both stream/river and lake fish populations. The mechanisms by which expansion would harm these fisheries are briefly discussed in sections 4.6.1, 4.6.2.1 and 4.6.2.2. In summary, expansion would reduce or eliminate many fish populations by: (1) causing unfavorable flow conditions in stream/river systems; (2) by increasing the sediment load in stream/river systems and in lakes; and (3) by increasing the nutrient loading of streams, rivers and lakes.

Table 4.11 gives an estimate of the number and area of fish bearing lakes in the province that would be negatively affected to some degree by expansion into the Green Area. Expansion would occur within the drainage basins of 14 per cent of the total number of fish bearing lakes in Alberta. Seventy-three per cent of the total area of all fish bearing lakes in the province would be negatively affected to some degree. Significant regional impacts would occur in the Northeast, Peace River and Eastern Slopes administrative regions.

Table 4.11

IMPACT OF GREEN AREA CONVERSION
ON KNOWN FISH BEARING LAKES

Administrative Region	Percent of total number and percent of total area (acres) of all fish bearing lakes in each region, which have some potential for agricultural expansion within their basins
Southern	Number = $\frac{0}{73}$ = 0% Area = $\frac{0}{104\ 379}$ = 0%
Central	Number = $\frac{0}{75}$ = 0% Area = $\frac{0}{112\ 745}$ = 0%
Eastern Slopes	Number = $\frac{28}{186}$ = 15% Area = $\frac{34\ 589}{83\ 593}$ = 41%
Peace River	Number = $\frac{66}{139}$ = 47% Area = $\frac{536\ 108}{777\ 366}$ = 69%
Northeast	Number = $\frac{20}{330}$ = 6% Area = $\frac{2\ 177\ 932}{2\ 710\ 576}$ = 80%
Provincial Total	Number = $\frac{114}{803}$ = 14% Area = $\frac{2\ 748\ 629}{3\ 788\ 659}$ = 73%

Table 4.12

IMPACTS OF GREEN AREA CONVERSION ON REGISTERED TRAPLINES

	ADMINISTRATIVE REGIONS					
	Southern	Central	Eastern Slopes	Peace River	North-east	Provincial Total
Total Current Trapline Area (000 acres)	40	152	18 358	52 720	24 343	95 612
Total Number of Traplines	2	4	390	1 017	602	2 015
Total Trapline Area Impacted	--	--	7%	15%	2%	10%
Total Number of Traplines Impacted	--	--	25%	51%	15%	35%
Total Number of Traplines which would be lost entirely with expansion	--	--	11%	24%	3%	15%

No estimate was made as to how many fish bearing streams and rivers would be negatively affected by expansion. It is clear, however, that a great many watercourses in the Northeast, Peace River and Eastern Slopes regions would be affected.

4.1.7 General Considerations

Expansion into the Green Area would impact many species in addition to the few species considered above. In general, species which are adapted to the conditions currently found within areas potentially suitable for expansion would be negatively affected by this development (see Table 4.3). The scale of the impact on a given species would depend on its sensitivity to agriculture and whether or not expansion tended to differentially take up land of a certain productivity for the production of that species.

For species where population reductions are a linear function of habitat loss, one might expect to observe, following expansion, a 10 to 20 per cent reduction in the population size of species living within the Boreal Mixedwood habitat region and a 20 to 30 per cent decline in the population size of species in the Boreal Foothills (see Table 4.2). A minor reduction would occur in populations of Boreal Upland and Boreal Northland species (Table 4.2).

If agricultural expansion tends to take up the best land for producing a given species, then the effect of expansion on that species would be greater. For example, expansion would take up only 18 per cent of current non-agricultural land in the Peace River administrative region (Table 4.1). However, this development would result in a 38 per cent decline in the potential capability of the region for moose production (Table 4.4). Expansion would tend to take up the most productive moose habitats. Similarly, population declines disproportionate to the area of agricultural expansion may occur for species which are sensitive to disturbance (for example Table 4.10).

It should be noted that expansion would enhance the provincial capability to produce certain species which are adapted to live in areas improved for agriculture. During favourable climatic periods, white-tailed deer for example would benefit from agricultural expansion. Many species classed as agricultural pests would similarly benefit. However, many species which are associated with agriculture in southern and central Alberta would likely not expand onto new agricultural lands in the Green Area due to inherent limiting factors associated with these areas. Pheasant populations for instance would not increase onto the new agricultural lands due to climatic factors.

Expansion into the Green Area would have a substantial negative effect on many stream, river and lake fish populations in central and northern Alberta.

Finally, it is apparent that expansion would have an important regional affect in the Peace River administrative region. The abundance and diversity of wildlife would decline in this region as a result of expansion. It would be more difficult to view and harvest many species as these human activities are forced to shift to non-productive habitats with resident wildlife populations at very low densities. Expansion would likely require a life style change for trappers, guides and other individuals who make their living directly from the fish and wildlife resource.

4.2 Timber Resources

The effect of Green Area Conversion on the timber resource was determined in terms of three factors: volume, area and annual allowable cut (AAC). Figures presented for each of these categories are expressed in both absolute amounts and as a percentage of the total value for each Forest (Table 4.13), the province (Table 4.13) and Forest Management Agreement areas (Table 4.14). Figure 7 identifies these various units.

From Table 4.13 it can be seen that the expansion alternative would affect approximately 25 per cent of the province's deciduous timber volume and only about 8 per cent of the provincial coniferous volume. This alternative would affect about 3.9 million acres (18 per cent of provincial total) of currently or potentially productive deciduous forests and about 1.8 million acres (7 per cent of provincial total) of currently or potentially productive coniferous forests. In total Green Area Conversion would affect about 5.7 million acres of currently or potentially productive forest in the province. Impacts on the various forests can be characterized as small, moderate and large. For the volume and area figures, these categories were defined as <5 per cent, 5-15 per cent and >15 per cent. The impacts can then be summarized as follows for coniferous timber: Edson, Rocky/Clearwater - small; Peace River, Lac La Biche - moderate; Footner, Grande Prairie, Slave Lake, Whitecourt - large. The impact on deciduous timber is higher overall as all impacts are moderate (Edson, Lac La Biche, Peace River, Rocky/Clearwater) or large (Footner, Grande Prairie, Slave Lake, Whitecourt). The loss of area (in per cent) is less than the volume loss in most cases; this indicates that the land potentially lost is of higher than average productivity.

Table 4.13

LOSS OF TIMBER VOLUME, AREA AND AAC UNDER GREEN AREA CONVERSION

FOREST	VOLUME (000 m^3)		PRODUCTIVE/ POTENTIALLY PRODUCTIVE AREA (000 acres)		ANNUAL ALLOWABLE CUT (000 m^3)			
	Coniferous	Deciduous	Coniferous	Deciduous	Coniferous		Deciduous	
					Total	Committed	Total	Committed
Edson								
Amount	269	727	5	8	2	1	9	7
%	3.8	7.9	0.2	0.2	4.5	4.5	8.4	8.4
Footner								
Amount	22 600	40 069	422	1 066	196	80	449	--
%	22.7	29.5	10.6	25.3	18.8	21.6	34.3	--
Grande Prairie								
Amount	25 173	56 769	320	789	320	319	753	651
%	19.1	33.9	15.8	43.8	18.9	18.9	45.4	45.7
Lac La Biche								
Amount	4 661	6 128	90	113	47	11	71	--
%	13.3	13.9	4.2	8.2	12.2	11.3	26.7	--
Peace R.								
Amount	11 688	31 728	163	548	80	62	357	79
%	9.2	15.5	7.3	19.7	9.6	12.1	18.5	10.9
Rocky								
Amount	410	1 884	9	30	6	1	20	1
%	1.7	9.6	3.8	6.1	2.5	1.7	9.4	6.5
Slave L.								
Amount	32 375	58 874	459	935	379	277	647	321
%	20.3	26.0	17.3	22.7	23.3	24.3	26.0	37.3
*								
Whitecourt								
Amount	22 996	24 217	365	368	433	364	255	83
%	15.1	24.9	16.3	29.6	20.8	24.0	31.6	29.3
Provincial TOTALS	120 172	220 396	1 833	3 855	1 462	1 115	2 560	1 142
%	8.0	25.1	6.7	18.0	9.8	14.7	23.9	31.3

*does not include Metis land

Table 4.14

LOSS OF TIMBER VOLUME, AREA AND AAC IN FOREST MANAGEMENT AGREEMENT AREAS UNDER GREEN AREA CONVERSION

FOREST	VOLUME (000 m^3)		PRODUCTIVE/ POTENTIALLY PRODUCTIVE AREA (000 acres)		ANNUAL ALLOWABLE CUT* (000 m^3)	
	Coniferous	Deciduous	Coniferous	Deciduous	Coniferous	Deciduous
Procter & Gamble						
Amount	11 333	27 916	156	415	168	493
%	12.3	34.7	10.3	33.8	12.4	44.6
Procter & Gamble (Provisional Reserve)						
Amount	2 689	5 073	41	114	28	77
%	4.0	10.6	4.7	10.8	4.2	10.9
Canadian Forest Products (CANFOR)						
Amount	12 620	14 989	139	181	155	162
%	30.8	47.1	41.8	29.7	36.3	48.5
Alberta Energy Company						
Amount	9 073	8 121	136	85	**	68
%	18.3	37.5	29.5	19.2	**	35.5

* Total AAC is equal to committed AAC in FMAs.

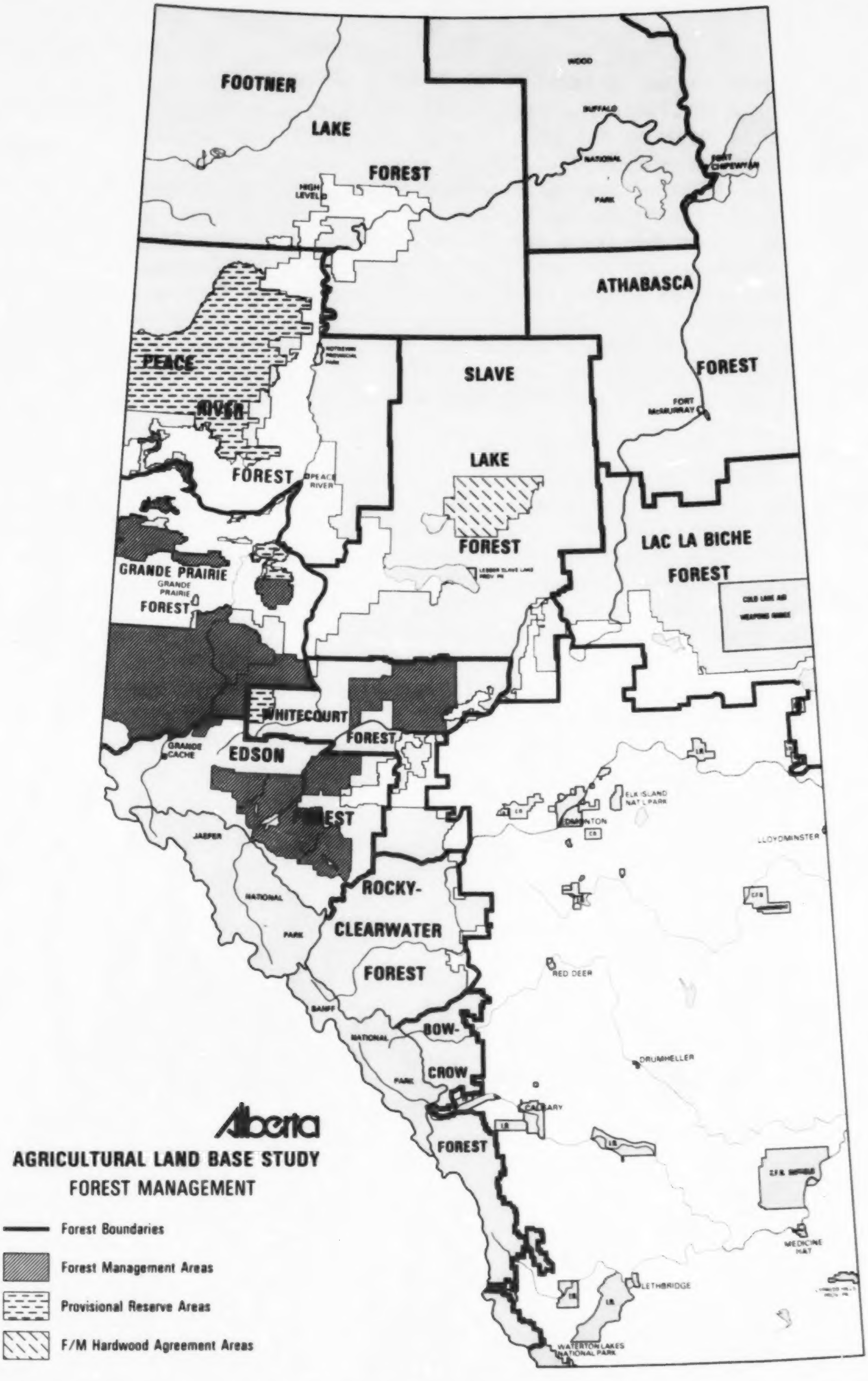
** No coniferous AAC.

Table 4.15

IMPACTS OF GREEN AREA CONVERSION ON PUBLIC RANGELANDS

FOREST	LOST AUMs	% OF FOREST TOTAL	% OF TOTAL PROVINCIAL AUMs IN THE GREEN AREA
Edson	1000	10	1
Grande Prairie	9100	39	7
Lac La Biche	400	18	<1
Peace River	1200	41	1
Rocky/Clearwater	2800	8	2
Slave Lake	3900	40	3
Whitecourt	4200	34	3
Bow/Crow Footner Athabasca	0	0	0
TOTAL AFFECTED	22 600		17
TOTAL in Green Area	135 000		---

NOTE: Includes some dispositions partially in the White Area.


FOOTNER
LAKE
FOREST
HIGH LEVEL
WOOD
BUFFALO
NATIONAL
PARK
FORT CHIPEWYAN
ATHABASCA
FOREST
FORT McMURRAY
PEACE
RIVER
FOREST
PEACE RIVER
SLAVE
LAKE
FOREST
LESSER SLAVE LAKE PROV. PK
LAC LA BICHE
FOREST
COLD LAKE AIR
WEAPONS RANGE
GRANDE PRAIRIE
GRANDE PRAIRIE
FOREST
WHITECOURT
FOREST
GRANDE CACHE
EDSON
FOREST
JASPER
NATIONAL
PARK
ELK ISLAND NAT'L PARK
EDMONTON
LLOYDMINSTER
ROCKY-
CLEARWATER
FOREST
RED DEER
BANFF
NATIONAL
PARK
BOW-
CROW
FOREST
DRUMHELLER
CALGARY
C.F.B. SUFFIELD
MEDICINE HAT
LETHBRIDGE
WATERTON LAKES NATIONAL PARK
I.R.
C.B.
Forest Boundaries
Forest Management Areas
Provisional Reserve Areas
F/M Hardwood Agreement Areas

Alberta

AGRICULTURAL LAND BASE STUDY
FOREST MANAGEMENT

PRODUCED BY THE RESOURCE EVALUATION AND PLANNING DIVISION, ALBERTA ENERGY AND NATURAL RESOURCES, 1985

The total AAC shown in Table 4.13 is the volume of timber available for disposition within each Forest, whereas committed AAC is that amount given to specific quota holders. As can be seen in the bottom row of Table 4.13 approximately 24 per cent of the provincial deciduous AAC and 31 per cent of the committed deciduous AAC would be affected by the expansion alternative. Impacts on coniferous AAC are considerably smaller as about 10 per cent of the total AAC and 15 per cent of the commited AAC would be affected. Some forests would lose most of the committed AAC (Edson, Grande Prairie, Peace River, Slave Lake, Whitecourt); others would lose mostly AAC that is not committed. In general, more committed coniferous AAC than deciduous AAC would be lost. The greatest reduction in coniferous AAC would occur in Slave Lake Forest (24.3 per cent) and the greatest deciduous AAC reduction in Grande Prairie Forest (45.7 per cent).

Volume, area and AAC effects in Forest Management Agreement areas are shown in Table 4.14. Canfor would sustain the largest losses of coniferous (30.8 per cent) and deciduous (47.1 per cent) volumes of timber. Over 40 per cent of the presently or potentially productive conferous area and almost 30 per cent of the presently or potentially productive deciduous area in Canfor would be affected. Canfor would lose over one-third of its commited coniferous AAC and almost one-half of its committed deciduous AAC. It should be noted that all AAC in Forest Management Agreement area is commited and all losses would have to be replaced by the province. The effects of Green Area Conversion are high on all Forest Management Agreement areas except the Procter and Gamble provisional reserve.

4.3 Public Rangeland Resources

The Alberta Forest Service manages grazing of domestic cattle in the Green Area that would be affected by the expansion alternative (Table 4.15). Approximately 22 600 AUMs or 17 per cent of the provincial total in the Green Area would be displaced. Losses would be largest in Grande Prairie Forest where 9 100 AUMs would be affected while Grande Prairie, Peace River, Slave Lake and Whitecourt Forests could each lose over one-third of the grazing presently provided to local farmers.

4.4 Recreation Resources

Recreation consequences are difficult to quantify. Existing Alberta Forest Service recreation sites are unlikely to be physically affected, but the quality of these areas could be decreased through lowered water quality, reduced aesthetic values, and conflicts between agriculture and dispersed recreation activities. These changes can only be determined on a site specific basis. Potential sites may be affected to a greater degree because agricultural clearing may result in a potential site becoming unsuitable for recreational development. Again, these can only be determined on a site specific basis. Table 4.16 lists sites that could be affected while Figure 8 shows the location of these sites.

4.5 Soil Resources

The problem of soil erosion on agricultural land is experienced throughout the province; however, due to a number of physiographic and climatic factors water erosion is particularly serious in northern Alberta. The combination of fine textured soils, undulating topography with deeply incised river channels, and excess moisture conditions makes the area very susceptible to erosion. In recent years erosion has become a serious problem in the farmlands of the Grande Prairie-Peace River region largely due to the construction of drainage projects and a change in farming techniques which favors using heavy machinery to farm large blocks of land without consideration for soil conservation methods. Much of the area consists of gently sloping land which is very susceptible to erosion if cultivated up and down the slope on long fields. Also the fine textured soils and dense subsurface horizons slow infiltration of surface water and require that drainage works be constructed to remove this water. The result of inadequate drainage design has been severe gullying problems where ditches enter the river valleys and has required expensive erosion control structures to prevent further damage.

In the areas outlined for agricultural expansion similar problems can be expected, and in many cases they may be considerably worse. Almost all of the CLI 1-4 land in the Green Area is grey luvisol soil as opposed to the dark grey and dark grey luvisol soils located in the adjacent White Area. The grey soils are derived from lacustrine clays and have a very fine texture and a low organic matter content. When these soils dry out they are reduced to a powdery consistency which is very easily eroded. The implications of clearing and cultivating these

Table 4.16

ALBERTA FOREST SERVICE RECREATION SITES POTENTIALLY AFFECTED BY GREEN AREA CONVERSION

FMU	EXISTING SITES	CLI RECREATION CLASS	COMMENTS
F15	Hutch Lake	5	Campground, Picnic Area
F13	Buffalo River	5,6	Picnic Area
G1	Hilltop Lake	5,6	Picnic Area
G5	Economy Lake	5,6	Campground, Picnic Area
G4	Big Mountain Creek	5,6	Group Camp, Trail Head (Snowmobile)
W2	Smoke Lake	5	Campground, Picnic Area
W2	Iosegun Lake	5,6	Campground, Picnic Area Trail Head (Snowmobile)
W4	Eagle River	5	Group Camp, Trail Head (Snowmobile)
S7	Lawrence Lake	5	Campground, Picnic Area
S5	Fawcett Lake	4	Campground, Picnic Area
L2	Tanasiuk	3	Campground, Picnic Area
L01	Siebert Lake	3	Campground, Picnic Area
*W5	Sandhills	5	Cross Country Skiing
*S7	Chain Lakes	4	Water Access Area
	PROPOSED SITES		
F12	Chinchaga River	5	Water Access Area
M1	Chinross	5	Water Access Area
G1	Ponita Lake, Albright Lake, Jackfish Lake, Betnal Lake, Cutbank Lake	5	Remote Camping
G1	Albright Creek, Ponita Lake	5	Group Camp
G4	Sand Dunes Area between Smoky & Wapiti River	5,6	OHV Area
G5	Washakegan	5	Auto Access Camping
G4	Bald Mountain Creek	6	Cross-country Skiing
G2C	Mountain Lake	5,6	Remote Camping
S15	Wabasca River	5,6	Remote Camping
S10	Wabasca River	6,7	Water Access
W1	Crooked Lake	5	Auto Access Camping
W3	Windfall Lake	5	Auto Access Camping
L2	Tanasiuk (Rock Island)	3	Expansion of Auto Access Campground

* These sites were recently developed and therefore do not appear in Figure 8.

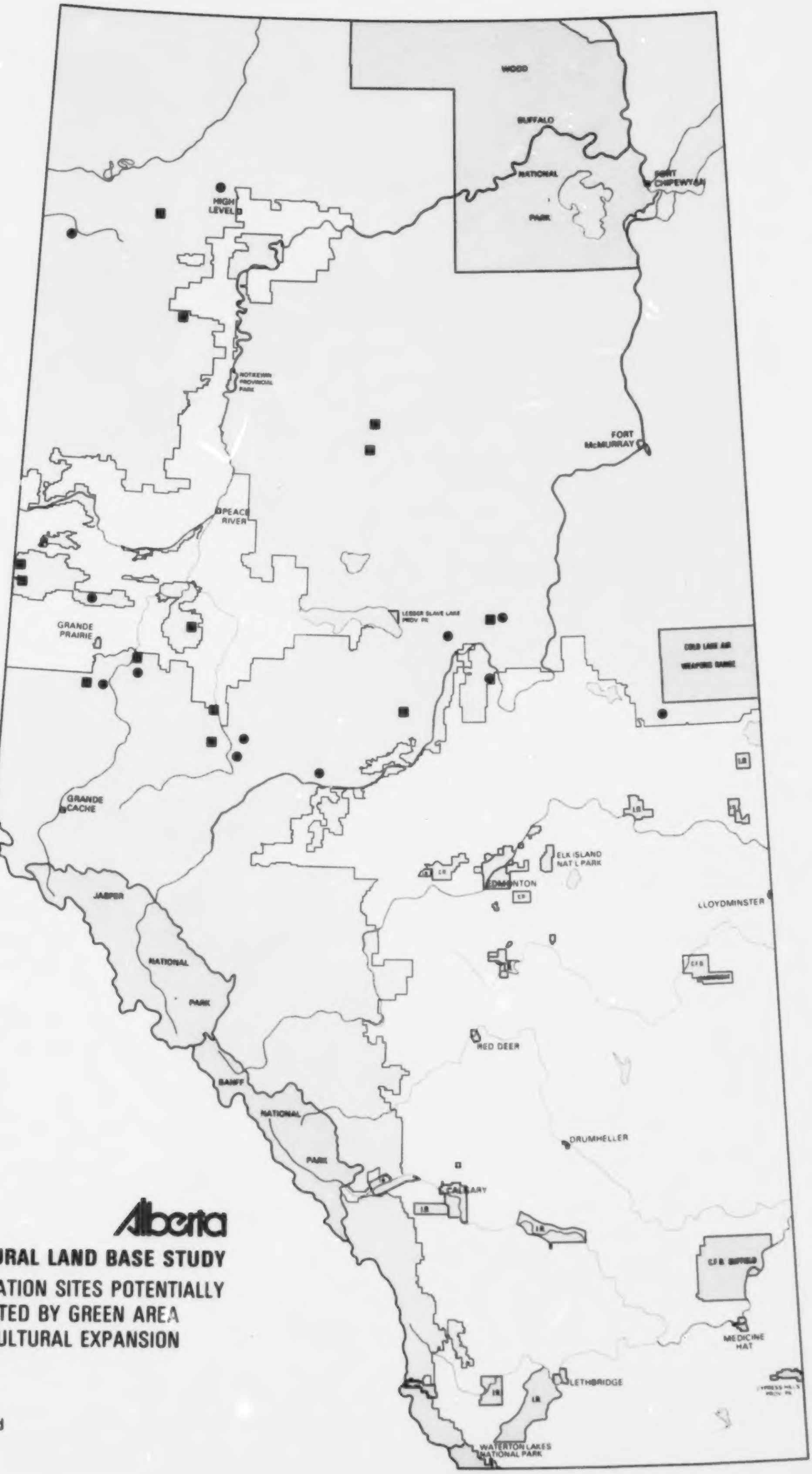
soils can then be quite serious, especially in areas with hilly topography and during times of drought. The practice of summerfallowing can also cause serious problems since it exposes the fragile soils to the elements. Recently the area of summerfallow in the Peace has been reduced due to recognition of its possible consequences and it is essential that this recognition be carried over to expansion areas in the Green Area.

The area outlined for expansion can be broken down, largely based on topography, in assessing the potential for erosion. Available data sources include a soil erodibility map prepared by Agriculture Canada (Figure 9) which assesses the water erosion potential of soils in Alberta, and assigns annual soil loss rates in tons/ha to most of the soil surveyed area of the province. The results indicate that the areas most susceptible to erosion are those with the greatest relief, specifically all lands south and southwest of Grande Prairie, and the area south and east of the Swan Hills. In these areas annual soil loss rates may be as high as 30 tons/ha, although loss from most areas is predicted to range from less than 6 to 22 tons/ha. These results were estimated assuming that the land is cropped with cereals under representative management techniques.

It should be noted that these are predicted values, based on the application of a soil loss formula and that actual values may be quite different. Chanasyk and Woytowich (1984) measured soil loss on a number of experimental plots in the Peace district and obtained maximum soil loss rates of 2.5 tons/ha on fallow land. They observed that the spring-melt runoff caused the greatest soil loss and that summer storms had varying impact depending upon the duration and intensity of rainfall.

Since Chanasyk's and Woytowich's work is the first of its kind conducted in Alberta it is impossible to say how serious the measured soil loss is. Further research is required to determine if this is a representative measurement, and if it represents substantial deterioration of the soil. The researchers note, however, that the thin topsoil layer and severe climate of the Peace district result in relatively slow rates of soil formation and therefore the soil's productive capability is easily damaged by erosion.

The implications of increased soil erosion extend beyond the farmer's field, since much of the soil removed eventually finds its way


WOOD
BUFFALO
NATIONAL
PARK
FORT CHIPEWYAN
HIGH LEVEL
ROTXEWIN PROVINCIAL PARK
FORT McMURRAY
PEACE RIVER
LESSER SLAVE LAKE PROV. PK.
COLD LAKE AIR WEAPONS RANGE
GRANDE PRAIRIE
GRANDE CACHE
ELK ISLAND NAT'L PARK
EDMONTON
LLOYDMINSTER
JASPER
NATIONAL
PARK
RED DEER
BANFF
NATIONAL
PARK
DRUMHELLER
CALGARY
C.F.B. SUFFIELD
MEDICINE HAT
LETHBRIDGE
CYPRESS HILLS PROV. PK.
WATERTON LAKES NATIONAL PARK
I.R.
C.F.B.

Alberta

AGRICULTURAL LAND BASE STUDY

AFS RECREATION SITES POTENTIALLY AFFECTED BY GREEN AREA AGRICULTURAL EXPANSION

● Existing

■ Proposed

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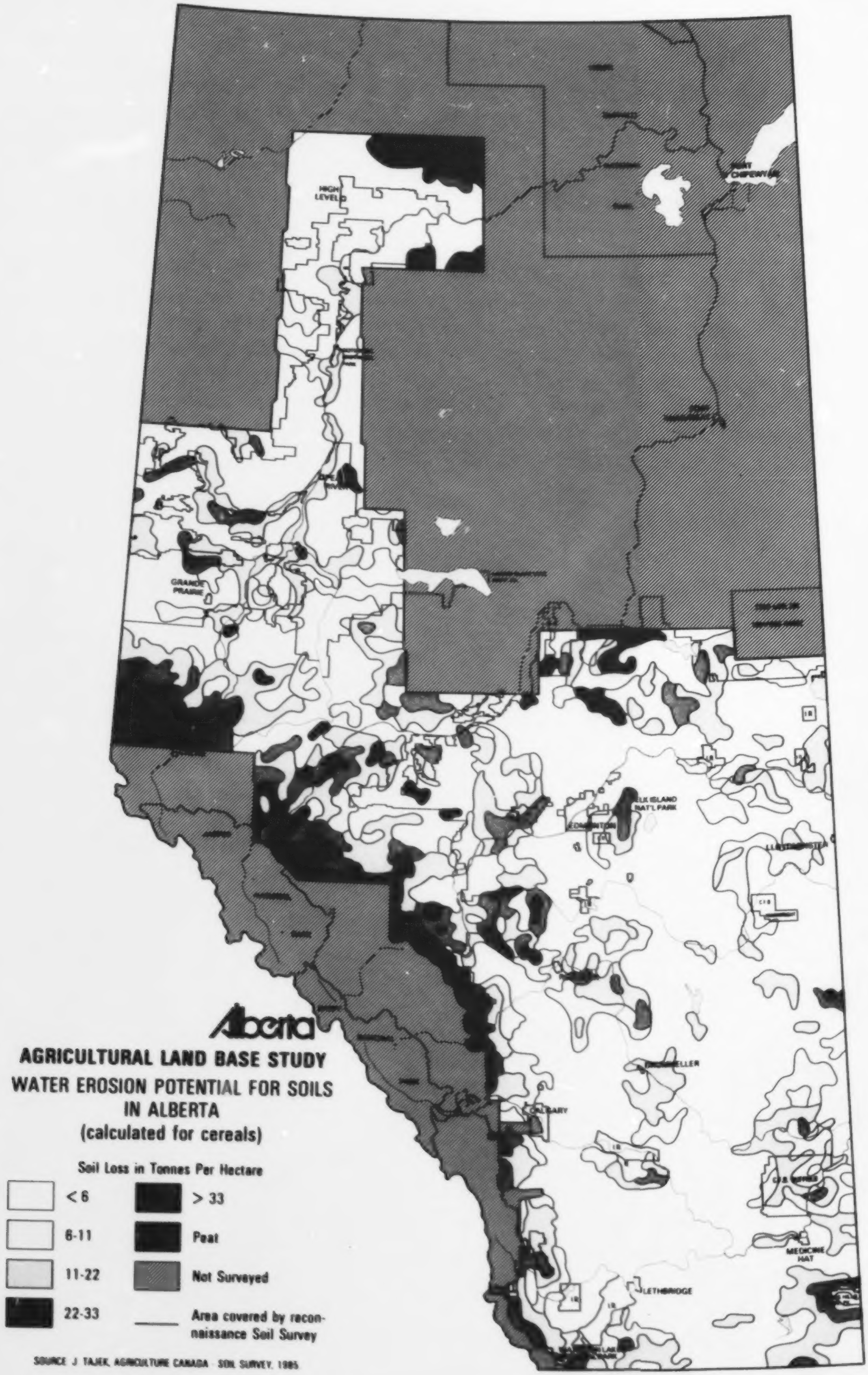

HIGH LEVEL
FORT CHIPEWYAN
PEACE RIVER
GRANDE PRAIRIE
ELK ISLAND NAT'L PARK
EDMONTON
LLOYDMINSTER
DRUMHELLER
CALGARY
MEDICINE HAT
LETHBRIDGE
Alberta
Soil Loss in Tonnes Per Hectare
< 6
6-11
11-22
22-33
> 33
Peat
Not Surveyed
Area covered by reconnaissance Soil Survey

AGRICULTURAL LAND BASE STUDY

WATER EROSION POTENTIAL FOR SOILS IN ALBERTA (calculated for cereals)

SOURCE: J. TAJEK, AGRICULTURE CANADA - SOIL SURVEY, 1985.

PRODUCED BY THE RESOURCE EVALUATION AND PLANNING DIVISION, ALBERTA ENERGY AND NATURAL RESOURCES, 1985.

into local watercourses where it may cause significant degradation in water quality. In addition to the obvious effects of siltation and increased turbidity, agricultural chemicals and nutrients such as phosphorus and nitrogen are carried into the streams with sediments. The effects of these pollutants will be examined in greater detail in subsequent sections dealing with water quality impacts.

In summary, the limited data available, and past experience in the region, indicates that soil erosion would be a problem in any portion of the Green Area opened for agricultural use. If development takes place at the scale proposed in the ALBS inventory the area of agricultural land in northwestern Alberta would increase by almost 200 percent. Considering the fact that the potential for erosion is even greater on portions of the area under study than on currently developed White Area land, it is apparent that erosion would be a serious consequence of this alternative.

4.6 Water Resources

4.6.1 Streamflow

At present very little data is available on the effects of agricultural land use on streamflows in Alberta. A number of studies have been conducted on the effects of clearing forests on water yields (Neill, 1980; Swanson and Hilmman, 1977; Stanton, 1966) and have concluded that water yield increases by 20 to 30 per cent after clearcutting of a forested area. Unfortunately these studies did not consider other uses of the cleared land and therefore the results cannot be used to predict surface runoff from agricultural land. Results from a study conducted on the Battle River (Stolte and Herrington 1980) indicate that water yields may actually be lower on agricultural land than on forested land. The authors speculated that greater water consumption by field crops, increased infiltration potential and increased soil moisture evaporation led to lower water yields from the agricultural watersheds, and decreased flows on the Battle River. It has also been observed in the USSR that farmland cleared from forest land yields less water than forest land, and it has been suggested that this difference is related to the enhancement and protection the forest cover provides to the snowpack (Pereira 1973).

These results are somewhat inconclusive and are indicative of the state of current research into the effects of land use on streamflow. Despite the uncertain nature of these conclusions some generalizations can be made in the northern Alberta case.

The initial result of clearing land would be increased runoff related to both elevated water yields from previously forested land and higher streamflow from wet areas that require drainage before they can be cultivated. The runoff produced from drainage may be significant since much of the land with agricultural potential is constrained by excess moisture and will require drainage. The potential therefore exists for significantly higher streamflow if large areas are cleared and drained simultaneously. In the lower reaches of rivers such as the Cadotte, Loon, Buffalo, Boyer and Wolverine this increase may produce flooding problems. The potential for flood damage is greatest in the most northerly areas of the Peace River area where flat, low lying lands are susceptible to flooding. In these regions flood problems have occurred in the past where agricultural development has taken place on the floodplain, and could occur with future development unless floodplain use is restricted.

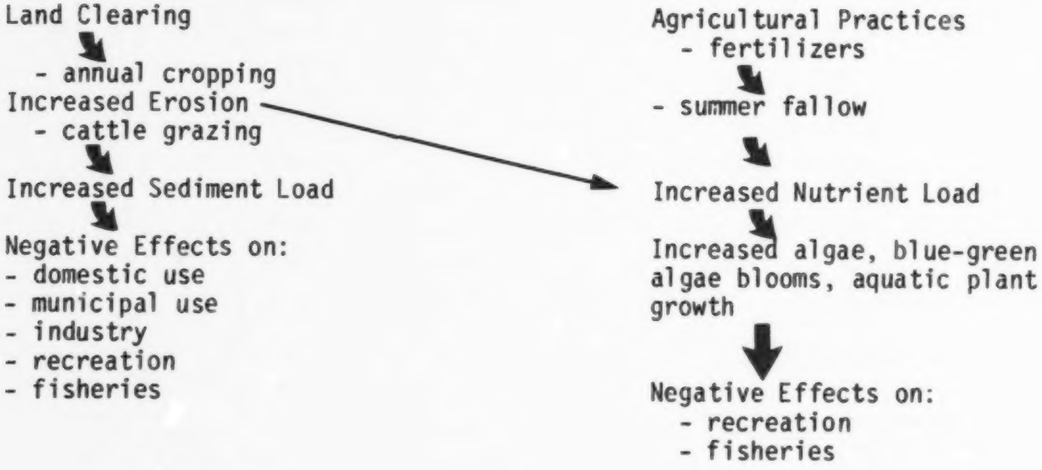
The water resource consequences of agricultural development can be separated into both short term and long term effects. The short term outcomes are those related to the initial drainage of land and the flooding problems caused by increased flows and development on the floodplain. In the long term the available evidence indicates that total water yield from cleared and cultivated lands could eventually drop below that produced from the original forested condition. The implications of this reduction in runoff would be limited to local streams since the larger rivers derive runoff from much greater areas and would not respond to localized runoff changes. However, on the local scale effects may be severe, especially when combined with the effects of drainage. The removal of wetland storage sites, and the acceleration of runoff through drainage, leads to lower baseflows, and when combined with lower surface runoff from cultivated land, leads to the possible exacerbation of low flow periods. These alterations also have the effect of intensifying flood flows by increasing flood peaks and shortening the period of flooding. With storage sites removed and stream channels straightened flood flows pass through the system rapidly, often causing greater flooding problems further downstream.

4.6.2 Water Quality

The effect on water quality of converting Green Area land to agricultural use is summarized in Figure 10 below:

Figure 10

Effects of Green Area Conversion on Water Quality


Land Clearing
- annual cropping
Increased Erosion
- cattle grazing
Increased Sediment Load
Negative Effects on:
- domestic use
- municipal use
- industry
- recreation
- fisheries
Agricultural Practices
- fertilizers
- summer fallow
Increased Nutrient Load
Increased algae, blue-green algae blooms, aquatic plant growth
Negative Effects on:
- recreation
- fisheries

4.6.2.1 Effect on Sediment Load

Section 4.5 indicates that soil erosion is likely to be severe in portions of the Green Area with capability for agricultural expansion. Much of the soil eroded from fields would find its way into watercourses causing degradation of water quality. This could cause a negative effect for municipal and domestic water users as well as for some industries and stockwatering. Fisheries could be negatively affected, especially spring spawning fish which would be deflected from entering some watercourses, thereby reducing spawning area. Also, if spawning does occur, hatching success could be significantly reduced due to smothering of the eggs and fry by accumulating silt.

When the sediment-bearing water flows into receiving lakes, silt will be deposited in the lakes creating ideal areas for aquatic plant growth. If areas of lakes which were previously gravel are affected, spawning areas for fish species such as lake whitefish would be severely affected.

4.6.2.2 Effect on Nutrient Loading

In addition to a conspicuous increase in silt load in the water, clearing could also cause an increase in nutrient load, notably phosphorus and nitrogen. As phosphorus has been identified to be the nutrient primarily responsible for limiting algal and aquatic plant production in Alberta lakes and has therefore been the focus of most studies, it will be the major topic in this discussion.

Accurate studies to determine nutrient (i.e. phosphorus) export from entire watersheds are an extremely expensive and difficult undertaking to accomplish. Also, most clearing of native forests was done long before there was either the interest or ability to do such studies; therefore detailed quantitative before and after information on the effect of extensive land use changes in large portions of basins is minimal. However, many studies have been done comparing phosphorus export from different sub-basins presently supporting different land uses.

Two such extensive watershed studies have been done by Alberta Environment, one in the Baptiste Lake basin (Trew et al. 1978), the other in the Wabamun Lake basin (Mitchell 1985). Average values for phosphorus export from land to receiving lakes for various land uses were determined:

Forested	0.1 kg/ha/yr
Mixed agricultural	0.5 kg/ha/yr

These values showed a five-fold increase in phosphorus export to lakes when land is converted from native vegetation to mixed agricultural use are similar to those by Lee et al. (1978) for other similar areas in North America.

A different approach to predicting the effect of agricultural development on phosphorus loading of streams was used by Stanley Associates (1985) for the Sturgeon Lake basin in northern Alberta. In this study, hundreds of "terrain cells" of varying soil type and slope were identified and the phosphorus export for each cell was predicted for various land uses. It was estimated that converting certain uncleared forested lands in the basin to mixed agricultural use would result, on average, in a six-fold increase in phosphorus exports from these lands. Increases in individual terrain cells ranged from 2 to 25-fold, depending on soil type, slope and distance to watercourses.

The extent of the increase in nutrient export from land to receiving lakes depends to some extent on the type of agricultural development with greater nutrient levels where fertilizers are extensively used, where annual cropping or summerfallowing is common, and where cattle numbers are high (i.e. grazing or feedlots). In order to establish the effect of cattle grazing on phosphorus export, Alberta Environment conducted a brief study in the Majeau Creek watershed of the Lac La Nonne basin comparing areas of various cattle density. The data indicated a positive correlation between cattle density and higher phosphorus loading (r = 0.72), similar to results found in a similar study in Iowa (Jones et al. 1976). Mean phosphorus concentration in the tributaries to Majeau Creek was 0.904 mg/L, significantly higher than that for tributaries to Wabamun Lake where cattle are few (0.201 mg/L) but similar to the tributaries from areas where cattle numbers are high (1.031 mg/L).

The most conspicuous effect of this increase in movement of phosphorus from the land to water would be in the increased eutrophication of lakes in the area. The density of blue-green algae, the frequency of noxious algal blooms, and the incidence and severity of fish kills would all increase with increased phosphorus loading. However, it is not possible to predict quantitatively either the rate or the magnitude of this increase due to the high degree of internal loading in the lakes in the portion of the Green Area most attractive for agricultural development. In lakes with internal loading, the amount of phosphorus released from lake sediments often far exceeds the annual phosphorus input from sources external to the lake; this has been demonstrated in many lakes in central and northern Alberta [Nakamun and Half-Moon (Riley 1983; Riley and Prepas 1984): Baptiste, Wabamun and Tucker (Trew et al 1978, Mitchell 1985): Sturgeon (Stanley Associates 1983)]. The effect of increased external phosphorus load cannot yet be predicted with accuracy but increased eutrophication is inevitable.

In conclusion, data collected to date indicates that clearing land of native vegetation will cause an increase in nutrient loading to streams, rivers and lakes. Agricultural use will further increase nutrient export, especially cattle grazing, feedlot operation, and areas of annual cropping and frequent summerfallowing. The effect of this increased eutrophication will be most conspicuous in lakes used for recreation and/or recreational, commercial or domestic fishing. In the areas of the Green Area with capacity for agricultural expansion many lakes are shallow and naturally very productive of algae and aquatic macrophytes. Recreational use of such lakes is already marginal, with complaints expressed regarding algal blooms and nuisance plant growth. Increasing nutrient loading to such lakes would decrease their recreational potential and may well make them very undesirable just when increased populations due to agricultural expansion would increase demand for recreation sites. Sturgeon Lake is a good example of conflict between recreation and agricultural expansion.

Fish production in many lakes in the area with capacity for agricultural expansion is naturally fairly high due to high algal and plant production, but is limited in some lakes due to low oxygen concentration in winter and summer as plant matter decomposes. Increased euthrophication would increase the incidence and severity of these fish kills. Studies of specific lakes would be needed to determine the severity of effects; in some cases, the fishery could be eliminated.

5. IRRIGATION EXPANSION

Climate is one of the most important factors influencing the range, yields and quality of crops grown in Alberta. The productivity of the semi-arid regions of southern Alberta can be substantially increased (from 60 to 200 percent) by irrigation. Approximately 8.9 million acres of land have fair to good physical potential for irrigation (Figure 11). However, water availability within this region is the major limiting factor for Irrigation Expansion. Recent estimates of the land area which may be irrigated using existing water supplies are contained in the South Saskatchewan River Basin Study (Alberta Environment 1984 and 1985a). This study predicts that the maximum acreage which can be irrigated in the basin is approximately 2.3 million acres or 1.1 million acres more than currently exists. Servicing such an area would involve the construction of a number of storage reservoirs and the maintenance of sufficient river flow to supply other users and to meet the requirements of interprovincial agreements with Saskatchewan. Since the study made no attempt to pinpoint the location of future expansion, except to say which basin it is located in, the assessment of impacts is somewhat more difficult than in other alternatives. The only criterion which can be placed on the new areas is that they will be located within the areas outlined as having a physical potential for irrigation on Figure 11.

5.1 Fish and Wildlife Resources

The analysis of Irrigation Expansion was made difficult in that the Agricultural Inventory Report does not identify specific areas where Irrigation Expansion could occur, given water availability constraints. Rather the inventory report identifies a large area of the province as having some potential for irrigation. For this impact assessment, it would not be useful to assume that new irrigation would be dispersed throughout all of the potentially irrigable lands. It was assumed that new irrigation would be directed towards currently unimproved land. Given this assumption, the following analysis presents a "worst case" impact assessment in terms of the amount of current non-agricultural land that could be taken up by irrigation. This is consistent with the approach taken in other components of the ALBS. The analysis examines how irrigation could impact wildlife resources associated with non-agricultural and unimproved lands.

5.1.1 Reduction of the Non-Agricultural Land Base

Tables 5.1 and 5.2 indicate the extent to which current non-agricultural land could be taken up by Irrigation Expansion given the above assumptions. All expansion potential occurs in the Southern and Central administrative regions (Table 5.1). Irrigation could take up 16 per cent of current non-agricultural land in the Southern Region and four percent of all non-agricultural land in the Central Region.

Irrigation Expansion would take up non-agricultural land in five habitat regions of the province (Table 5.2). This loss of non-agricultural land would be greatest in the Shortgrass Prairie (-16 per cent and in the Mixed Grass Prairie (-8 per cent).

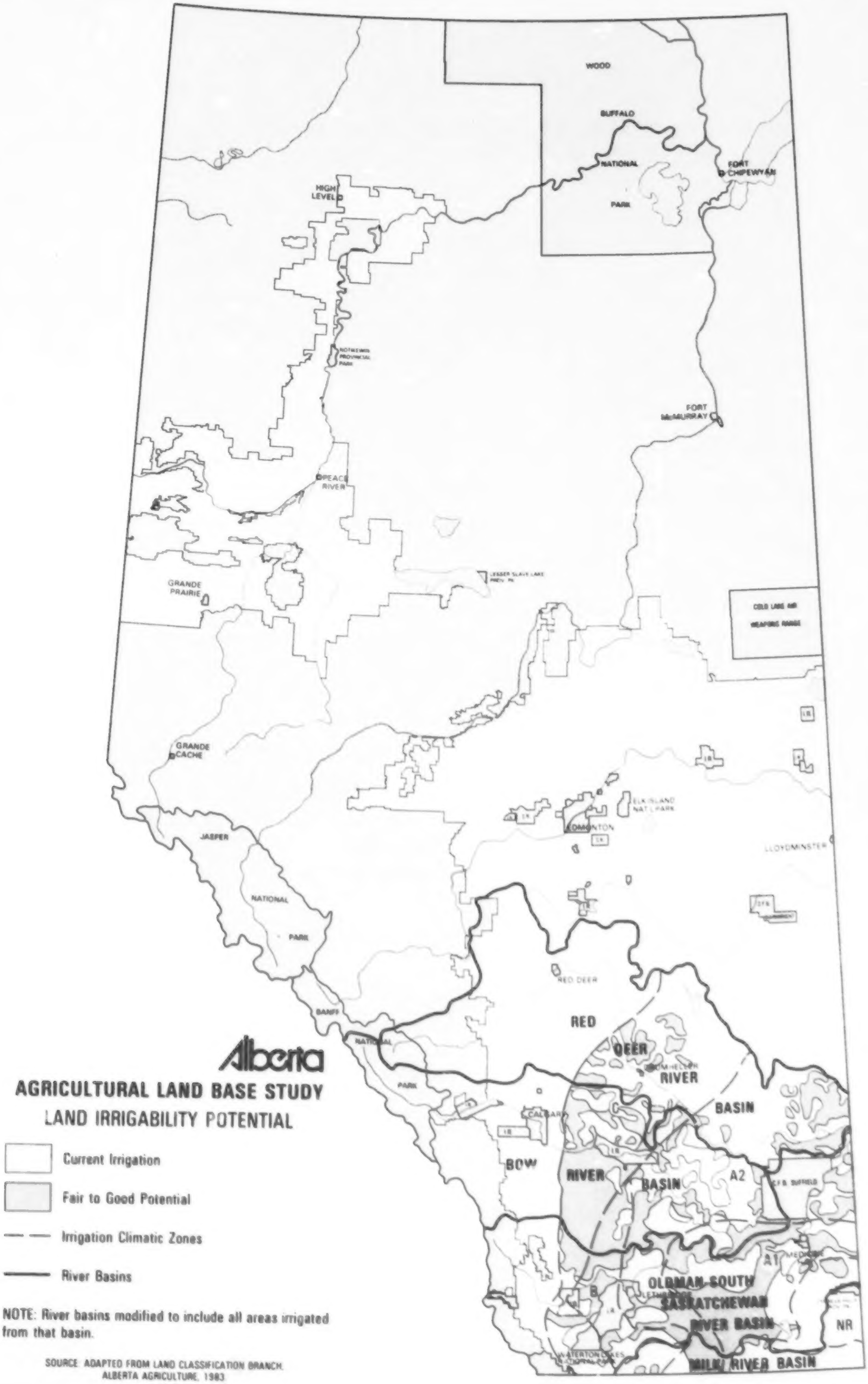
5.1.2 Impacts on Wildlife Species in General

Irrigation Expansion could negatively affect populations of most mammal and bird species in the prairie regions of Alberta (Table 5.3). Sixty-one to 65 per cent of all mammal species found in the three prairie habitat regions would be negatively affected. Approximately 68 per cent of all breeding bird species in these three prairie habitat regions would be negatively affected. A smaller number of mammal and bird species in the Aspen Parkland and Montane habitat regions could be negatively affected. Overall, Irrigation Expansion would negatively affect 26 mammal species which is 32 per cent of all mammal species found in the province. Of these 26 species, nine species are subject to licenced consumptive use. Irrigation Expansion would negatively affect 96 breeding bird species. These 96 species comprise 39 per cent of all breeding birds found in Alberta. Twenty-two of the 96 bird species are subject to licenced consumptive use.

5.1.3 Impacts on the Potential to Produce a Series of Wildlife Species

Table 5.4 indicates the extent to which Irrigation Expansion could alter the regional and provincial capability for producing antelope, mule deer and white-tailed deer. Table 5.5 indicates how irrigation expansion could alter habitat quality for these species.

The potential to produce mule deer in the Southern Region could decline by 19 per cent. This reduction in potential capability would occur due to a significant decline in mule deer habitat quality in the southern region (Table 5.5). The capability of the Southern Region


WOOD
BUFFALO
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PARK
FORT CHIPEWYAN
HIGH LEVEL
NOTIKEWIN PROVINCIAL PARK
FORT McMURRAY
PEACE RIVER
LESSER SLAVE LAKE PROV. PK.
GRANDE PRAIRIE
COLD LAKE AIR WEAPONS RANGE
GRANDE CACHE
ELK ISLAND NAT. PARK
EDMONTON
LLOYDMINSTER
JASPER
NATIONAL
PARK
RED DEER
BANFF
NATIONAL
PARK
RED
DEER
DRUMHELLER
RIVER
BASIN
CALGARY
BOW
RIVER
BASIN
A2
C.F.B. SUFFIELD
C
A1
MEDICINE HAT
B
OLDMAN-SOUTH
SASKATCHEWAN
RIVER BASIN
LETHBRIDGE
NR
WATERTON LAKES NATIONAL PARK
MILK RIVER BASIN
IR

Alberta

AGRICULTURAL LAND BASE STUDY

LAND IRRIGABILITY POTENTIAL

☐	Current Irrigation
▨	Fair to Good Potential
— —	Irrigation Climatic Zones
▬	River Basins

NOTE: River basins modified to include all areas irrigated from that basin.

SOURCE: ADAPTED FROM LAND CLASSIFICATION BRANCH, ALBERTA AGRICULTURE, 1983

PRODUCED BY THE RESOURCE EVALUATION AND PLANNING DIVISION, ALBERTA ENERGY AND NATURAL RESOURCES, 1985

Table 5.1

POTENTIAL REDUCTION OF NON-AGRICULTURAL OR UNIMPROVED LAND THROUGH IRRIGATION EXPANSION BY ADMINISTRATIVE REGION.

Administrative Region	Potential Development (000 acres)	Potential Development as % of Non-Agricultural or Predominently Unimproved Land in Each Region
Southern	900	16%
Central	200	4%
Eastern Slopes	--	--
Peace River	--	--
Northeast	--	--
Provincial Total	1 100	1%

Table 5.2

POTENTIAL REDUCTION OF NON-AGRICULTURAL OR UNIMPROVED LAND THROUGH IRRIGATION EXPANSION BY HABITAT REGION

HABITAT REGION	Potential Development (000 acres)	Potential Development as % of Non-Agricultural or Predominently Unimproved Land in Each Region
Shortgrass Prairie	887	16%
Mixedgrass Prairie	149	8%
Fescue Grasslands	40	5%
Aspen Parkland	23	1%
Montane	1	<1%
Subalpine	--	--
Alpine	--	--
Boreal Mixedwood	--	--
Boreal Foothills	--	--
Boreal Uplands	--	--
Boreal Northlands	--	--
Boreal Subarctic	--	--
		--
Provincial Total	1 100	1%

Table 5.3

MAMMAL AND BIRD SPECIES NEGATIVELY IMPACTED BY IRRIGATION EXPANSION*

Habitat Region	Mammal Species	Breeding Bird Species
Shortgrass Prairie	$\frac{19}{31}$ = 61%	$\frac{83}{123}$ = 67%
Mixedgrass Prairie	$\frac{16}{26}$ = 62%	$\frac{86}{126}$ = 68%
Fescue Grasslands	$\frac{13}{20}$ = 65%	$\frac{81}{120}$ = 68%
Aspen Parkland	$\frac{13}{36}$ = 36%	$\frac{76}{154}$ = 49%
Montane	$\frac{10}{50}$ = 20%	$\frac{42}{132}$ = 32%
All Others	--	--
Provincial Total	$\frac{26}{82}$ = 32%	$\frac{96}{245}$ = 39%

* Many individual species occur in more than one habitat region.

Note: There are no impacts on resident non-breeding or migrant bird species.

Table 5.4

IMPACTS OF IRRIGATION EXPANSION ON THE CAPABILITY TO PRODUCE SELECTED UNGULATES

Net number of animals lost or gained and percentage change relative to total current potential capability.

	ADMINISTRATIVE REGIONS		
	Southern	Central	Provincial Total
Antelope	-3 294 (-22%)	-578 (-8%)	-3 872 (-18%)
White-Tailed Deer	-586 (-5%)	-125 (-1%)	-711 (-1%)
Mule Deer	-4 233 (-19%)	-481 (-2%)	-4 714 (-3%)

This is less than 10 per cent of the total amount of land (both public and private) with a physical potential. It is unlikely that a major expansion of irrigation would impact public land to a great extent. However, to be consistent with the approach taken in the study it was assumed that all 762 000 acres of public land with a potential could be developed for irrigation.

Table 5.7 summarizes the maximum potential impacts of irrigation expansion on public rangelands. The 762 000 acres of public rangelands potentially impacted by Irrigation Expansion is about 10 per cent of the total of ublic rangelands in the White Area. The loss of 126 000 AUMs involved is about 8 per cent of the total provided on public land in the White Area. About 628 000 acres of this total would be located in the Brown Soil Zone of the Southern Region. This is about 20 per cent of

Table 5.5

EFFECTS OF IRRIGATION EXPANSION ON HABITAT SUITABILITY CLASSES FOR SELECTED UNGULATE SPECIES

Net change in the amount of available habitat (000 acres) and percentage change relative to total current habitat.

	ADMINISTRATIVE REGIONS						
HABITAT SUITABILITY CLASS*	ANTELOPE			WHITE-TAILED DEER		MULE DEER	
	Southern	Central	Provincial Total	Southern	Central	Southern	Central
1	-2 348 (-42%)	-167 (-57%)	-2 515 (-42%)	-38 (-3%)	-21 (-1%)	-671 (-23%)	-41 (-1%)
2	+800 (+33%)	-191 (-4%)	+609 (+9%)	-263 (-12%)	-21 (<-1%)	-936 (-28%)	-225 (-3%)
3	+1 204 (+49%)	-19 (-1%)	+1 185 (+31%)	-17 (<-1%)	-13 (<-1%)	+1 335 (+21%)	+201 (+3%)
4	+344 (+11%)	+377 (+4%)	+721 (+1%)	+318 increase is from zero	+55 increase is from zero	+272 increase is from zero	+65 increase is from zero

* Refer to the following tables for ungulate densities to be expected with each habitat suitability class: Antelope (Table 11.5), White-Tailed Deer (Table 4.7) and Mule Deer (Table 4.8).

for antelope production would decline by 22 per cent with irrigation expansion. Similarly, the provincial capability for antelope production would decline by 18 percent. Irrigation could substantially reduce the availability of first class antelope habitat in Alberta (Table 5.5) while it would have only a small effect on white-tailed deer production (Table 5.4) and white-tailed deer habitat (Table 5.5).

As indicated on Table 5.6, Irrigation Expansion could make it somewhat more difficult to achieve the provincial population goals for antelope, mule deer and white-tailed deer. This effect would be most significant for antelope.

5.1.4 Fisheries

The impacts of Irrigation Expansion on fisheries are related to the effects of streamflow variability and water quality degradation due to irrigation withdrawals. These effects are discussed in sections 5.4.1 and 5.4.2.

5.1.5 General Considerations

It was assumed in the above analysis that irrigation expansion would tend to be directed towards current non-agricultural land. If indeed this occurs, then Irrigation Expansion would take up a moderate amount of currently unimproved land in the prairie regions of the province. As indicated on Table 20, expansion would typically be a negative influence to the populations of bird and mammal species which currently use these unimproved lands. It is possible that Irrigation Expansion would not be directed primarily towards current unimproved land. Irrigation Expansion could occur solely on lands which currently are under dryland farming. It is likely that such a change in land use would have a relatively small effect on wildlife populations. Indeed if hedge rows and the margins of newly irrigated fields are allowed to remain in, or are enhanced into, an undeveloped state, then certain wildlife species might substantially benefit from the increased forage availability associated with irrigation. However, the conversion of dryland farming areas to irrigation will have a negative influence on most wildlife species if the farming practices associated with irrigation are to be more intensive from dryland farming practices.

5.2 Public Rangeland Resources

Approximately 762 000 acres of public land (not including the Special Areas) in southern Alberta has physical potential for irrigation.

Table 5.6

CHANGES IN PRODUCTION CAPABILITY FOR SELECTED UNGULATES,
RESULTING FROM IRRIGATION EXPANSION,
IN RELATION TO THE "FISH AND WILDLIFE STATUS REPORT".

Antelope:

Current Actual Population = 15 000
Actual Population Following Conversion= 12 349
Status Report Goal = 18 000

Mule Deer:

Current Actual Population = 73 000
Actual Population Following Conversion = 70 659
Status Report Goal = 100 000

White-Tailed Deer;

Current Actual Population = 118 000
Actual Population Following Conversion = 113 696
Status Report Goal = 125 000

Note: See Table 10 for an example of how these were calculated

the total acres of public rangelands in the Southern Region. The effects on lost AUMs would also be greatest in the Brown Soil Zone of the Southern Region. Lesser impacts would occur in the Dark Brown Soil Zone. All potentially irrigable land in the Provincial Grazing Reserves is also located in this region. The Bow Island Grazing Reserve contains the majority of this land (34 000 acres).

These potential losses are considered to be quite small from the provincial perspective. Local impacts could be important, however, if all the public rangeland is lost in one areas. Perhaps even more important is the potential impact on the traditional lifestyle of ranching in Alberta.

Table 5.7

POTENTIALLY IRRIGABLE PUBLIC LAND AND IMPACTS ON GRAZING (excluding the Special Areas)

	Area (000 acres)	AUMs (000 AUMS)
Southern Region*		
Brown Soil Zone	628	126
Grazing Reserves	45	9
Dark Brown Soil Zone	52	10
Grazing Reserves	--	--
Central Region*		
Dark Brown Soil Zone	37	13
Grazing Reserves	--	--
TOTAL AFFECTED	762	158
PROVINCIAL TOTAL IN THE WHITE AREA	7 287	1 874
TOTAL AFFECTED AS % OF PROVINCIAL TOTAL	10%	8%

* See Figure 2, p. 13.

The impacts of irrigation expansion in the Special Areas were difficult to determine because of the lack of accurate maps of land ownership at an appropriate scale for the ALBS. A map displaying land ownership from Alberta Energy and Natural Resources Land Status Automated System was used to identify potentially irrigable public land in the Special Areas. It was determined that there are about 200 000 acres of potentially irrigable public land in the Special Areas. This represents about two per cent of the total 8.9 million acres having fair to good physical potential for irrigation within the study area. The majority of this land area is under grazing disposition but a portion is also under cultivation disposition. It is not possible to estimate these ratios as part of this study.

5.3 Recreation Resources

The impacts of Irrigation Expansion on recreation are related to the effects of reduced river flow and lower reservoir levels on boating, and the effects of water quality deterioration on contact recreation. These effects are discussed in sections 5.4.1 and 5.4.2.

5.4 Water Resources

5.4.1 Water Quality

The analysis of water quality impacts was carried out using a water quality modelling simulation for the entire South Saskatchewan basin. This model predicts the effects that reductions in flow caused by increased irrigation withdrawals would have on water quality in the four major rivers in the basin. Since the level of acceptability of water contaminants varies considerably depending upon the use of water, the level of impact was assessed for five different water uses. For each use, criteria were defined only for those parameters which have the greatest impact on that use. As Table 5.8 illustrates, two criteria levels were set to identify major and minor impacts. Levels below the lower criteria indicate no impact on that use.

The results of this analysis are contained in Table 5.9 which illustrates predicted water quality impacts under average and low flow conditions assuming that only existing municipal sewage treatment facilities are used.

Table 5.8

SUMMARY OF SPECIFIC USE WATER QUALITY CRITERIA
(Units in mg/l unless shown otherwise.)

	COLD WATER FISHERY		WARM WATER FISHERY		PUBLIC WATER SUPPLY		CONTACT RECREATION		IRRIGATION		INDUSTRIAL	
	Major Impact	Minor Impact	Major Impact	Minor Impact	Major Impact	Minor Impact	Major Impact	Minor Impact	Major Impact	Minor Impact	Major Impact	Minor Impact
Conductivity us/cm									2 500	1 000		
Total Dissolved Solids						1 000						1 000
Temperature °C	23	22	29	28			20					37
Oxygen	4	5	3	4								
Unionized Ammonia	.04	.03	.04	.04								
Total Ammonia												40
Nitrate					10							8
Sulphate					500							600
Phosphorus												4
Trophic State		Eutrophic		Eutrophic			Eutrophic	Mesotrophic		Hypereutrophic		
Total Coliforms						5 000	1 000			1 000		
Alkalinity												500
pH						8.5						8.9

SOURCE: South Saskatchewan River Basin Planning Program, Scenario Report (Alberta Environment 1984).

Table 5.9

WATER QUALITY IMPACTS FROM MAXIMUM IRRIGATION EXPANSION

RIVER REACH	Public Water Supply		Fish Habitat		Industry		Contact Recreation		Irrigation	
	A	L	A	L	A	L	A	L	A	L
RED DEER										
Above Red Deer										
Below Red Deer				I			I	I		i
Below Dinosaur Park							I	I		
BOW										
Above Calgary										
Below Calgary	i	i	i	I			I	I	i	i
Below Bassano				I			I	I		i
OLDMAN										
Above Lethbridge			i	I				i		
Below Lethbridge		i	I	I			I	I	i	i
Below Taber		I		I		i	I	I		i
SOUTH SASKATCHEWAN										
Below Medicine Hat			i	I			I	I	i	i

i - minor impact
I - major impact
blank - acceptable

A - average flow year
L - low flow year

SOURCE: South Saskatchewan River Basin Planning Program, Scenario Report (Alberta Environment 1984).

The most severe impacts occur on fish habitat and contact recreation in the lower Red Deer, Bow, and Oldman Rivers (Table 5.9). In these reaches increased temperature and low dissolved oxygen reduce the quality of fish habitat, and the presence of algae and pathogens associated with sewage effluents limit recreational uses. Minor impacts may also occur on public water supply and irrigation uses due to high levels of dissolved solids and salts, particularly in the downstream reaches of the three rivers.

5.4.1.1 Salinity Pollution

One of the major negative impacts of irrigated agriculture in arid and semi-arid areas is increased soil and water salinity. In Alberta 250 000 acres or 25 per cent of the total of approximately 1.1 million acres of irrigated land is currently affected by salinity. The practice of irrigation produces salinity pollution in four ways: canal seepage, upslope recharge, surface ponding and inefficient irrigation. In Alberta it is estimated that 70 per cent of the irrigated lands affected by salinity are attributable to canal seepage.

Canals were originally constructed on natural contour lines regardless of soil conditions and are often located on side hills and on coarse textured soils resulting in substantial seepage potential. Poor irrigation practices also result in salinity problems as over-irrigation often leads to the concentration of salts on the soil surface. Any increase in irrigated acreage would likely produce greater soil salinity problems; however, through proper irrigation management and careful canal construction these impacts can be minimized.

Another potentially more serious aspect of the salinity problem is the effect that saline drainage effluent has on watercourses. Even under good irrigation practices, salts are leached from the soil profile and carried into watercourses by drainage waters and drainage effluent. When combined with reduced river flows caused by irrigation withdrawals these salts can have a potentially serious impact on river water quality. At present no deleterious effects of salt loading have been measured in the South Saskatchewan River basin, however, little data is available and it is difficult to predict if this condition would result under future irrigation expansion.

Various studies on the effects of irrigation in the South Saskatchewan River Basin have attempted to measure both salt loading and pesticide and nutrient pollution from irrigation drainage effluent. These studies indicate generally low pesticide levels, well within environmental criteria, and varying salt levels, none at dangerously high levels (Durrant 1982). A study carried out by the Pollution Control Division of Alberta Environment indicated that the salt load of water diverted into the Irrigation Districts was actually higher than in return flows. This result indicates an accumulation of salt within the districts, which may be cause for some concern in the long term.

The primary conclusion which can be drawn from these studies is that further data collection is required to measure current water quality and to allow the running of a model to predict salt loading after Irrigation Expansion. The experience of the western United States where irrigation-salinity is one of the major water quality problems affecting the area's rivers indicates that sufficient research must be undertaken to ensure that Irrigation Expansion would not have a negative effect on water quality in the South Saskatchewan basin.

5.4.2 Streamflow

The expansion of irrigated acreage to its theoretical maximum in Southern Alberta may produce both positive and negative impacts in terms of river flow and water users in the South Saskatchewan River basin. Doubling the acreage of irrigated land would require the construction of a number of storage reservoirs to supply irrigators and would, in some river reaches, produce higher, more stable flows. In other areas increased irrigation withdrawals would result in very low flows, particularly during drought years.

Water users most affected by periodic low flows are recreationists and fisheries. The impacts on fish habitat are illustrated in Table 5.10 and indicate general improvement in fish habitat in the Red Deer River and deterioration in the Bow and Oldman. These impacts are related to the variability in flows that would occur in the Bow and Oldman Rivers due to heavy irrigation withdrawals.

The effects on recreation are described in Table 5.11 which illustrates the results of a simulation of water levels under the irrigation water use required to support maximum expansion. The impacts described refer to the effects of low flows on recreation activities such as boating, fishing and aesthetics. Major impacts occur in the lower Bow and the entire Oldman basin, while minor to moderate effects are evident on the Red Deer River. Severe impacts, which would occur in the Oldman, Waterton, St. Mary and Belly Rivers, are indicative of

Table 5.10

FISH HABITAT IMPACTS FROM MAXIMUM IRRIGATION EXPANSION

Reach	Impact Rating
Red Deer River	
Below Dickson Res.	4
Near the Mouth	4
Bow River	
Below Calgary	2
Below Bassano	1
Oldman River	
Below LNID Diversion	1
Below Lethbridge	2

*Impact Ratings

5	Habitat significantly improved over historical conditions. Very stable flows. (Rated as "Acceptable").
4	Habitat somewhat improved over historical conditions. (Rated as "Acceptable").
3	Habitat near historical conditions. (Rated as "Acceptable").
2	Habitat somewhat impaired. Moderate flow variability. (Rated as "Moderate Impact").
1	Habitat severely impaired. Flow variability extreme and/or frequent. (Rated as "Severe Impact").

SOURCE: Alberta Environment 1984.

Table 5.11

RECREATION IMPACTS FROM IRRIGATION EXPANSION

Reach or Reservoir	Frequency of Violation by Month*			Designated Impact**
	June	July	Aug.	
Reach				
Red Deer River				
Below Dickson Res. (41)	6	2	1	min
Below Red Deer (42)	4	0	4	min
Below Drumheller (44)	4	0	3	min
Below Dinosaur Prov. Park (45)	13	23	23	maj
Bow River				
Above Calgary (36)	--	--	--	
Below Calgary (37)	--	--	--	
Below Carseland (39)	--	--	--	
Below Bassano (40)	3	9	14	mod
Oldman River				
Above Lethbridge (53)	1	21	18	maj
Below Lethbridge (54)	--	7	8	min
Below Taber (47)	--	6	11	mod
Waterton River				
Below Waterton Res. (55)	22	28	26	maj
St. Mary River				
Below St. Mary Res. (59)	8	21	21	maj
Belly River				
Below Waterton R. Confluence (58)	5	18	21	maj
South Saskatchewan River				
Below Bow-Oldman Confluence (69)	--	4	4	min
Below Medicine Hat (46)	--	5	7	min
RESERVOIR				
Red Deer Sub-basin***				
Dickson	2	2	2	mod
Bow Sub-basin				
Chestermere	3	6	11	mod
Minnewanka	--	--	--	
Spray	--	--	--	
Upper Kananaskis	--	--	--	
Lower Kananaskis	--	--	--	
Barrier	--	--	--	
Ghost	28	28	--	maj
Bearspaw	--	--	--	
Oldman Sub-basin				
McGregor	2	5	8	min
Travers	2	4	5	min
Little Bow	--	--	--	
Paine Lake	--	--	--	
Chain Lake	1	1	3	
Keho	20	20	22	maj
Waterton	1	2	4	mod
St. Mary	1	9	14	maj
Jensen	1	1	3	
Milk River Ridge	1	1	2	

* Number of months during 28 year simulation that the reservoir elevation or the channel flow was less than the minimum desirable recreation level.

** "Blank" indicates acceptable:
min - minor impact; mod - moderate impact; maj - major impact

*** All of the sub-basins are "geographic" sub-basins.

SOURCE: Alberta Environment 1984.

the fact that current recreation conditions on these three rivers are marginal and that further flow reductions may preclude recreational use altogether. Water levels in reservoirs in the basin are generally acceptable except for extreme drawdowns in the Ghost, Keho, and St. Mary reservoirs.

In assessing the importance of the impacts described, some mention should be made of the current recreation use of the waterbodies under discussion. Surveys carried out by the SSRB study indicate that the most heavily used areas are the Red Deer River between Red Deer and Drumheller, the Bow River from Bearspaw Reservoir to the Carseland weir, and Chestermere Lake and Travers Reservoir. The use of rivers tends to decrease in the downstream reaches, and of the remaining reservoirs only those in the foothills area (Kananaskis Lakes, Spray Reservoir, Lake Minnewanka, Chain Lakes and Keho Lakes) are extensively utilized by recreationists.

The expansion of irrigated acreage would also produce some benefits for other water users in Southern Alberta. In the past municipalities and industry have obtained secure water supplies from irrigation canals and from river flow augmented by storage reservoirs. Future development would provide increased flows in existing channels, and may provide new water sources for towns and industries in areas of new irrigation expansion.

5.5 Soil Resources

5.5.1 Effects on Wind Erosion

Soil drifting can occur on irrigated lands because most irrigated crops leave little or no trash cover and crop residues are often fed to livestock. The risk of erosion also increases because some crops do not provide much wind protection in the spring. In many cases these impacts can be mitigated through appropriate on-farm management techniques. Summerfallow should not be necessary on irrigated lands because barrier strips, fall plowing, fall irrigation and/or cover crops are excellent preventative control measures (Alberta Agriculture 1980).

6. DRAINAGE

The assessment of the potential for agricultural drainage was carried out in a separate study entitled: "Drainage Potential in Alberta: An Integrated Study" (1986). This study was funded primarily by the Alberta Water Resources Commission and coordinated by an interdepartmental steering committee with membership from the Department's of Environment, Agriculture, and the Fish and Wildlife Division of Forestry, Lands and Wildlife.

The objective of the drainage inventory was to develop a provincial scale assessment of the area of agricultural land affected by excess moisture and to estimate the potential for drainage given a number of physical, environmental and socio-economic constraints. The study was conducted in three phases, the first two involving the selection of an appropriate inventory method and the inventory itself, and the third; the analysis of drainage feasibility. The inventory was carried out using aerial photography of sample areas scattered throughout the province and extropolating the results to produce an estimate of the total wetland area in the White Area of the province. Wetlands were classified according to type using a classification system developed by the study team. This system classified wetlands as: slough/marsh (temporary or permanent), seeps, bog/fen, lake/pond, sheetwater, or watercourse. The inventory indicated that wetlands were much more prevalent in Northern Alberta, especially in the Beaver, Athasbasca and Peace basins, and to a lesser extent in the North Saskatchewan basin, than in the southern portion of the province. For this reason the study limited itself to northern basins.

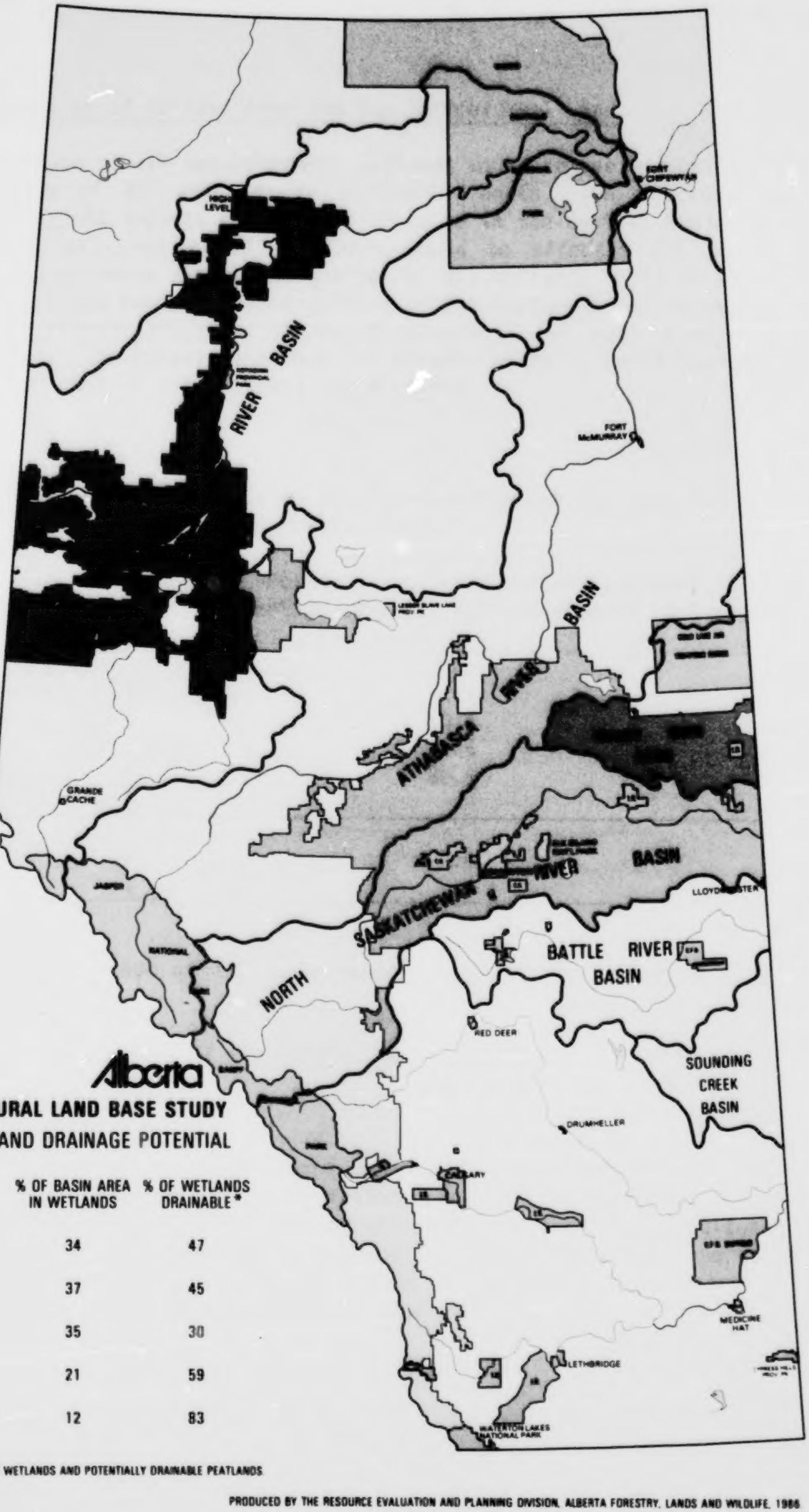
The total area of all wetland types in northcentral and northwestern Alberta amounted to approximately 9.4 million acres, however only a small percentage (22 per cent) of this total can be considered drainable. Due to environmental and economic constraints it was decided that only temporary slough/marsh, seeps, and sheetwater should be classified as drainable non-permanent wetlands. These areas total 2.1 million acres and represent the area which will be considered as having potential for drainage and will form the basis for the analysis of impact

6.1 Fish and Wildlife Resources

This section outlines the potential effects of agricultural drainage of all non-peat wetlands (except lake/pond and permanent slough/marsh) in the White Area of northern Alberta. To facilitate the analysis of impacts on wildlife resources it was assumed that this part of northern Alberta corresponds to Forestry, Lands and Wildlife's Northeast, Eastern Slopes and Peace River Regions combined (Figure 2 p.13). Data from Phase II of "Drainage Potential in Alberta: An Integrated Study" (1986) was used to extrapolate the areas of wetlands found in three habitat regions (Aspen Parkland, Boreal Foothills and Boreal Mixedwood). These areas were then adjusted for each administrative region. The total drainable wetland area was expressed as a function of total wetland area to estimate the percent reduction in total wetlands.

The potential reduction of herbaceous/shrub/tree cover through drainage was estimated in the following manner. It was assumed that a vegetation band with a width of 50 feet would be lost along the margin of all drained wetlands. The perimeters of all non-peat wetlands with vegetated margins were calculated from Phase II of the Inventory of Alberta's Drainage Requirements and extrapolated over the study area. The loss of habitat was estimated by summing the areas of affected wetland margin (perimeter length times 50 feet). This calculated loss of habitat was compared to the total current area of noncultivated land, as given in the map showing current agricultural land use (Figure 4 Dominant Agricultural Land Use), to indicate the percent reduction in non-agricultural land. This non-agricultural land was rated in terms of suitability for moose, white-tailed deer, mule deer, ringnecked pheasant and sharp-tailed grouse on a habitat subregion basis. Numbers were then calculated for administrative regions.

Effects of wetland drainage on waterfowl were evaluated by comparing the total wetlands that are drainable in the study area to the total wetlands in the White Area and the Green Area. These areas were weighted as to their suitability for waterfowl habitat. These weighting factors were derived from the dabbling duck and diving duck habitat suitability models developed as part of Phase II of the "Drainage Potential in Alberta. An Integrated Study" (1986). A similar procedure was used to determine effects on aquatic furbearers using beaver and muskrat habitat suitability models. Additional analyses were conducted on the potential effects of drainage on duck and goose production levels. Regional annual production estimates were multiplied by the proportion of habitat loss to estimate the production potential that could be lost as a result of agricultural drainage.


HIGH LEVEL
RIVER BASIN
FORT CHIPEWYAN
FORT McMURRAY
LESSER SLAVE LAKE PROV. PK.
ATHABASCA RIVER BASIN
GRANDE CACHE
JASPER NATIONAL PARK
NORTH SASKATCHEWAN RIVER BASIN
LLOYDMINSTER
BATTLE RIVER BASIN
RED DEER
SOUNDING CREEK BASIN
BANFF
PARK
CALGARY
DRUMHELLER
MEDICINE HAT
LETHBRIDGE
CYPRESS HILLS PROV. PK.
WATERTON LAKES NATIONAL PARK

Alberta

AGRICULTURAL LAND BASE STUDY

WETLANDS AND DRAINAGE POTENTIAL

RIVER BASINS	% OF BASIN AREA IN WETLANDS	% OF WETLANDS DRAINABLE*
■	34	47
▩	37	45
■	35	30
▨	21	59
□	12	83

*INCLUDES NON-PERMANENT WETLANDS AND POTENTIALLY DRAINABLE PEATLANDS

PRODUCED BY THE RESOURCE EVALUATION AND PLANNING DIVISION, ALBERTA FORESTRY, LANDS AND WILDLIFE, 1986

6.1.1 Reduction of Wetland Area and Non-Agricultural Land

Drainage of all non-permanent wetlands would remove approximately 22.4 per cent of all wetlands in northern Alberta. On a percentage basis, the largest impacts on wetlands would be in the Central Region where more than 80 per cent of all wetlands would be affected and in the Northeast Region where almost one-quarter of all wetlands would be affected. The Aspen Parkland habitat region portion of the Northeast administrative region would receive the greatest impact as over 90 per cent of wetlands would be lost. The Boreal Mixedwood and Boreal Foothills would lose about 19 and 12 per cent of all wetlands respectively.

Table 6.1

Potential Reduction of Total Wetland Area Through Drainage by Administrative Region*

Administrative Region	Potential reduction of wetland area as percentage of total wetland area in each region
Eastern Slopes	7.1
Peace River	10.6
Northeast	24.6
Central**	82.9
Total	22.4

*Based on the drainage of all non-permanent wetlands in the White Area of each Region.

**Approximately one-half of the Central Region is in Northern Alberta.

Drainage of wetlands would result in the clearing of some currently non-cultivated upland vegetation. Only in the Northeast Region would more than one percent of the current unimproved or non-agricultural land be affected. The greatest impact would occur in the settled portions of the Aspen Parkland of Northeast Region where about 25 per cent of current undeveloped or non-agricultural land would be lost.

6.1.2 Impacts on Wildlife Species in General

Table 6.2 gives a summary of how drainage would affect individual mammal and bird species found in the province. Drainage would negatively affect 72 to 84 per cent of all mammal species living in the three noted habitat regions in the province. The mammal fauna of the Boreal Mixedwood and Boreal Foothills would be espectially affected. Of the 47 species in the province that would be affected, 27 species are currently subject to licensed consumptive use. All of the 47 species are used non-consumptively.

A large number of breeding bird species would be negatively affected by drainage. Seventy-three per cent of all breeding bird species in the province would be negatively affected. The negative effects of drainage would be realized for breeding bird species in three

habitat regions. Approximately 80 per cent of all species would be affected in these regions. About 22 per cent of resident non-breeding bird species in the Aspen Parkland or 15 per cent of the provinces species would be affected. Drainage would affect about 56 per cent of all bird species that migrate through Alberta. These species are primarily arctic nesting waterfowl and shorebirds. Of all bird species that would be affected by drainage 38 species are currently subject to licensed consumptive use while all species have non-consumptive value.

Table 6.2

Mammal and Bird Species Negatively Impacted by Drainage*

Habitat Region	Mammal Species	Breeding Bird Species	Resident Non-Breeding Bird Species	Migrant Bird Species
Aspen Parkland	$\frac{26}{36}$ = 72%	$\frac{122}{154}$ = 79%	$\frac{2}{9}$ = 22%	$\frac{14}{24}$ = 58%
Boreal Mixedwood	$\frac{38}{45}$ = 84%	$\frac{141}{179}$ = 79%	--	$\frac{14}{24}$ = 58%
Boreal Foothills	$\frac{38}{45}$ = 84%	$\frac{117}{143}$ = 82%	--	$\frac{4}{5}$ = 80%
Provincial Total	$\frac{47}{82}$ = 57%	$\frac{179}{245}$ = 73%	$\frac{2}{13}$ = 15%	$\frac{14}{25}$ = 56%

* Many individual species occur in more than one region.

** Eight resident non-breeding bird species are also counted as breeding bird species in other regions of the province.

6.1.3 Impacts on the Potential to Produce a Series of Wildlife Species

Table 6.3 indicates the extent to which maximum drainage would reduce the potential to produce moose, white-tailed deer and mule deer. These numbers were estimated by simply multiplying the proportion of regional habitat loss (from Table 6.1) by the regional population for each species. Provincial population declines were determined by summing the calculated declines for each administrative region.

The potential for approximately 1 670 moose would be lost through drainage which is about 1.0 per cent of the provincial potential. Declines would be greatest in the Northeast region. The potential to produce about 2 500 white-tailed deer or 2.1 per cent of the provincial total would be lost. The regional decline would again be greatest in the Central Region. In totals just under 2 500 mule deer would be lost which is over three per cent of the provincial potential.

It should be emphasized that the above analysis is based on the assumption that a 50 foot band of vegetation would be removed around wetlands. If a wider strip is removed then effects would be amplified. Upland game birds like ring-necked pheasants and sharp-tailed grouse also use vegetation surrounding wetlands as part of their habitat. Impacts on ring-necked pheasants would be low in northern Alberta because of low populations. Impacts on sharp-tailed grouse would be greater as the potential production of over 1 000 birds (1.3 per cent of the current population) would be lost.

Drainage of non-permanent wetlands would have a significant impact on waterfowl populations in northern Alberta (Table 6.4). These numbers were compiled by consulting waterfowl management experts in the province. Over 9 million ducks would be lost from the average fall population (1970-1979). This is about 54 per cent of the provincial population. The greatest impact would be in the Northeast where over 3 600 000 or 21 per cent of the fall population would be lost.

Table 6.3

Impacts of Drainage on the Capability to Produce Selected Ungulates

Net number of animals lost or gained and percentage change relative to total current potential capability.

	Administrative Region			
	Eastern Slopes	Peace River	Northeast	Central*
Moose	-170 (-0.4)%	-425 (-0.6)%	-709 (-1.6)%	- 366 (-5.3)%
White-Tailed Deer	-42 (-0.4)%	-78 (-0.6)%	-856 (-1.6)%	-1 490 (-5.3)%
Mule Deer	-144 (-0.4)%	-147 (-0.6)%	-522 (-1.6)%	-1 684 (-5.3)%

* Approximately one-half of the Central Region is in Northern Alberta.

6.1.4 General Considerations

Drainage would act to significantly reduce the diversity of landscapes and habitat types found in northern Alberta, and particularly in the Northeast administrative region. Drainage would not only affect the wetlands, but also the upland vegetation found in conjunction with these wetlands. By far the greatest impact would be on fall populations of ducks and geese. Ungulates, upland game birds and a broad variety of other mammals and birds would be affected but actual numbers lost would be quite low.

Table 6.4

Impacts of Drainage on the Capability to Produce Selected Waterfowl*

Administrative Region	Net Number of Animals Lost and % Change Relative to Current Production	
	Ducks	Geese
Eastern Slopes	201 000 (-25%)	--
Peace River	3 256 000 (-80)%	--
Northeast	3 611 000 (-80)%	--
Central**	-2 029 000 (-86.1)%	
Total	-9 097 000 (-80.2%)	-56 000 (-33.3%)

* Based on the drainage of all non-permanent wetlands in the White Area of each Region.

**Approximately one-half of the Central Region is in Northern Alberta.

6.2 Soil Resources

The major impact that agricultural drainage would have on the soil resource is increased rates of erosion. Any attempt to accelerate the removal of water from the farm could produce soil erosion both on the fields, and in drainage ditches. The potential for erosion is greatest in the Peace District as previous experience with drainage projects has illustrated. In this region fine textured soils, undulating topography and limited natural drainage combine to make drainage improvements a high risk proposition which can produce disastrous impacts in the form of sheet erosion on the farmer's fields and gullying and streambank erosion in receiving watercourses. However, techniques such as on and off-farm upstream water retention could significantly reduce and minimize environmental impacts. Total impacts are lowest if adequate designs to restrict the rate of flow are implemented initially.

6.3 Water Resources

Drainage has the potential to produce significant hydrological and water quality impacts in the basins and sub-basins where it will be concentrated. These impacts are summarized in Figure 13.

6.3.1 Hydrological Impacts

The drainage of 2.1 million acres of wetlands in Northern Alberta represents a significant increase over current levels of drainage and has the potential to create major erosion and flooding impacts downstream. Wetlands in their natural state represent substantial storage sites capable of absorbing flood flows and releasing them slowly. If these storage sites are removed by drainage, flood flows pass directly through the system and may produce significantly higher flood peaks in downstream reaches. These increased flows will have much greater erosive capacity and can lead to substantial streambank and bed erosion.

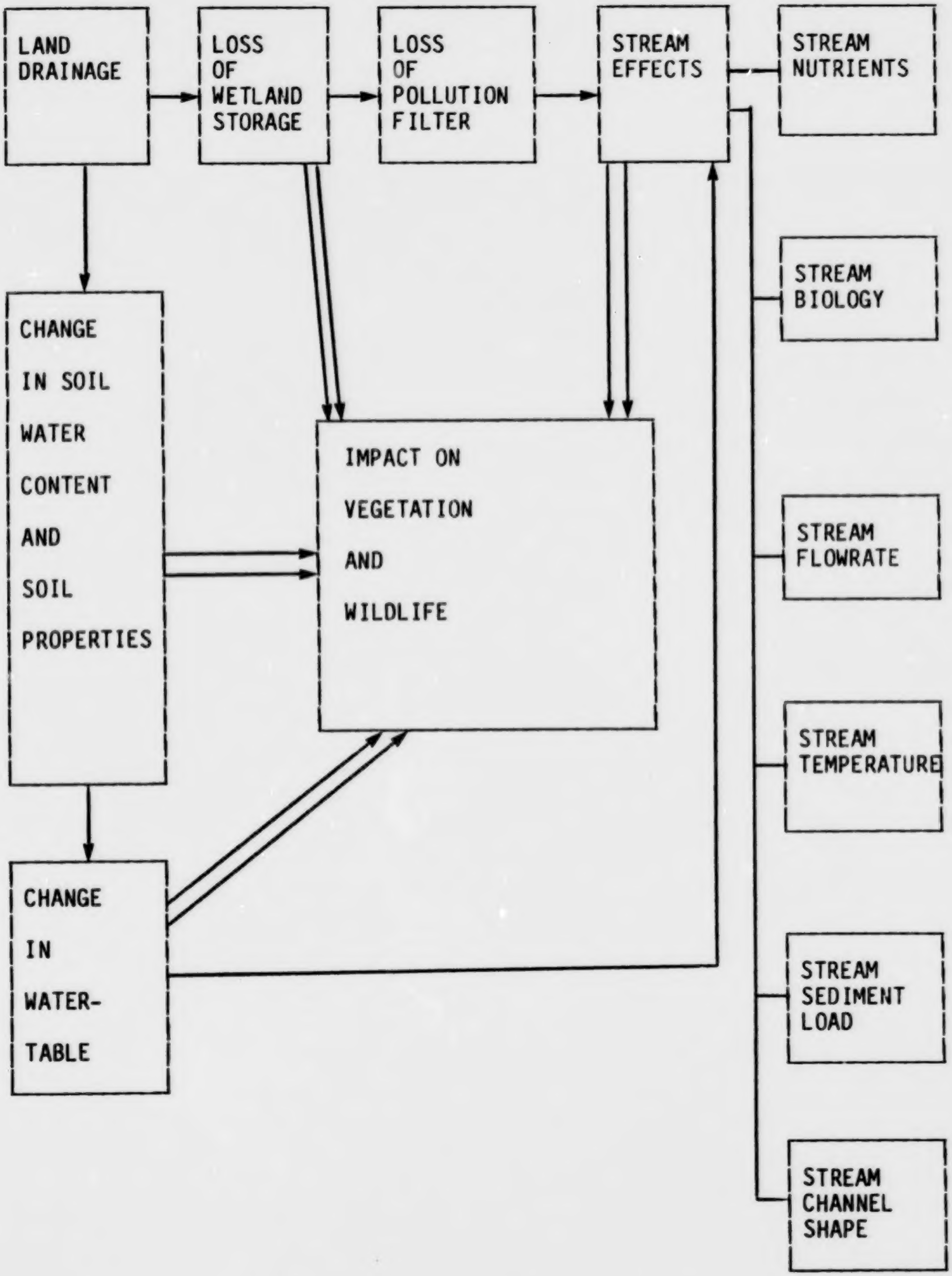

LAND DRAINAGE
LOSS OF WETLAND STORAGE
LOSS OF POLLUTION FILTER
STREAM EFFECTS
STREAM NUTRIENTS
STREAM BIOLOGY
STREAM FLOWRATE
STREAM TEMPERATURE
STREAM SEDIMENT LOAD
STREAM CHANNEL SHAPE
CHANGE IN SOIL WATER CONTENT AND SOIL PROPERTIES
IMPACT ON VEGETATION AND WILDLIFE
CHANGE IN WATER-TABLE

FIGURE 13 ENVIRONMENTAL IMPACT OF DRAINS
Source: Whiteley, 1979

During drought periods wetlands play a similar storage role and will provide significant contributions to baseflow in local streams. Draining wetlands removes this source of flow and will result in much lower flows during extreme dry periods. Wetlands are also important in the recharging of groundwater reserves and their removal may lead to decreases in water table levels.

The severity of the impacts described above is very dependent upon local conditions and cannot be predicted with any accuracy at this scale. However, it is safe to say that some level of these impacts can be expected unless mitigation measures are taken.

6.3.2 Water Quality Impacts

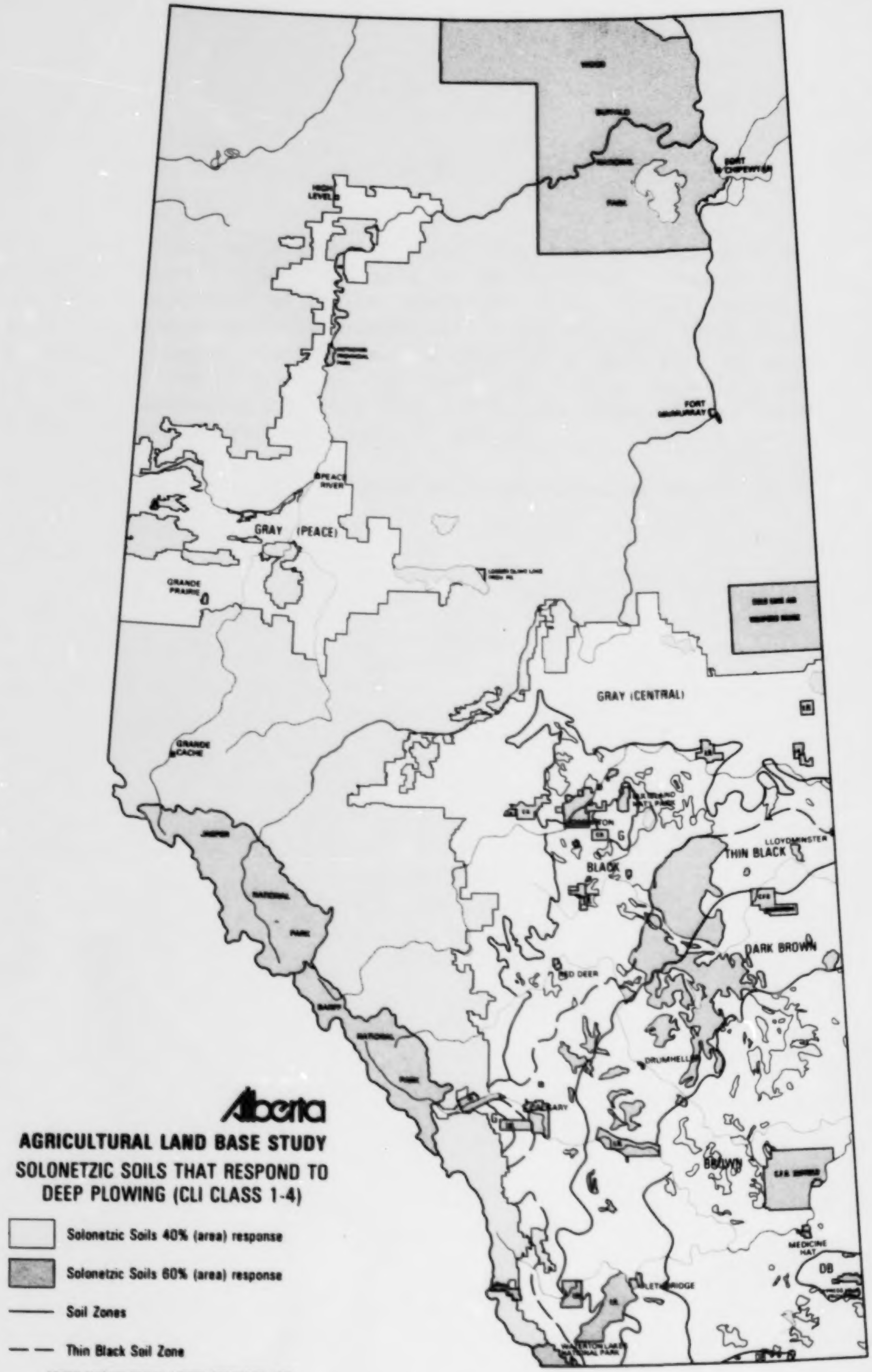
Farm drainage waters may contain a host of contaminants which can have detrimental effects on water quality in receiving streams. These contaminants include salts, nutrients such as Nitrogen and Phosphorus, heavy metals, suspended solids and herbicides and pesticides. Surface drainage effluents in particular may contain high concentrations of nutrients, pesticides, and suspended solids. These contaminants can lead to significant deterioration of receiving waters through lowered dissolved Oxygen concentrations and the promotion of algal blooms and accelerated eutrophication.

Wetlands also have significant value as pollutant filters. Due to the high level of biological activity in many wetlands they consume large amounts of nutrients and they may bind toxic materials such as heavy metals and pesticides to aquatic vegetation or sediments in the slough or marsh. The result is improved water quality in streams flowing out of wetlands and it is suspected that water quality without this filtering activity may be significantly diminished.

7. DEEP PLOWING

Solonetzic soils are characterized by an impermeable hardpan layer which severely restricts root and water penetration. They are generally less fertile and their productivity depends largely on the depth of overlying topsoil. The productivity of some solonetzic soils can be increased by deep plowing. Deep plowing physically breaks up the hardpan layer, mixes the soil by diluting the sodium with calcium from lower levels and improves the soil structure. While there are about 10.7 million acres of solonetzic soils in Alberta, less than 2.2 million acres can be made more productive through deep plowing (Figure 14).

No potential impacts on other resources have been identified.


WOOD
BUFFALO
NATIONAL
PARK
FORT CHIPEWYAN
HIGH LEVEL
FORT McMURRAY
PEACE RIVER
GRAY (PEACE)
GRANDE PRAIRIE
GRAY (CENTRAL)
GRANDE CACHE
JASPER
NATIONAL
PARK
EDMONTON
BLACK
THIN BLACK
LLOYDMINSTER
DARK BROWN
RED DEER
BANFF
NATIONAL
PARK
DRUMHELLER
CALGARY
BROWN
C.F.B. SUFFIELD
MEDICINE HAT
DB
LETHBRIDGE
WATERTON LAKES NATIONAL PARK

Alberta

AGRICULTURAL LAND BASE STUDY

SOLONETZIC SOILS THAT RESPOND TO DEEP PLOWING (CLI CLASS 1-4)

☐ Solonetzic Soils 40% (area) response

▨ Solonetzic Soils 60% (area) response

—— Soil Zones

— — Thin Black Soil Zone

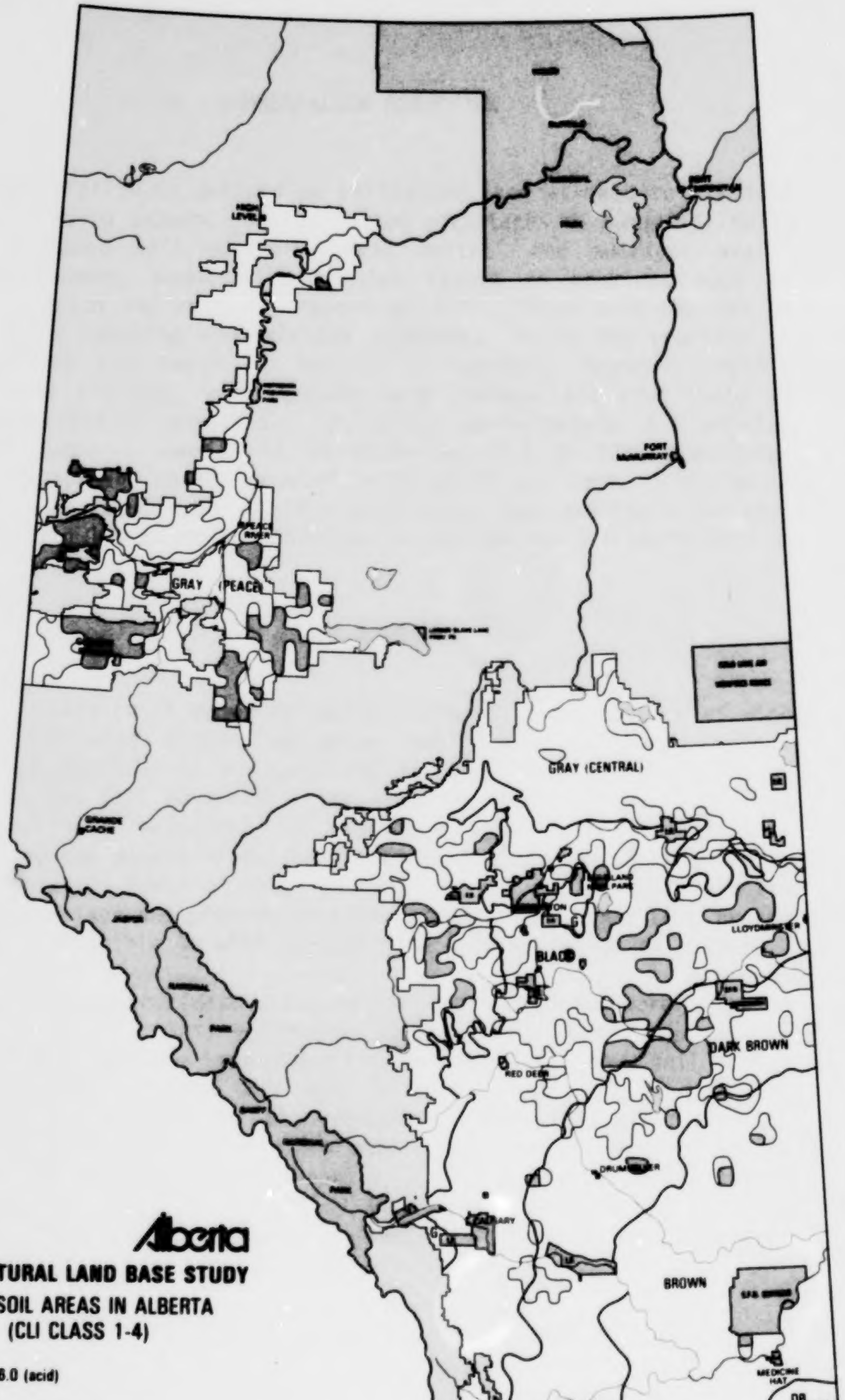
SOURCE: LAND USE BRANCH, ALBERTA AGRICULTURE, 1985

PRODUCED BY THE RESOURCE EVALUATION AND PLANNING DIVISION, ALBERTA ENERGY AND NATURAL RESOURCES, 1985

8. LIMING

In Alberta, soils with a pH level less than or equal to 6 are considered acidic. Soil pH affects the physical, chemical and biological properties of soils which in turn, affect nutrient availability and reduce crop production. Crops vary greatly in their tolerance to acidity. To overcome the problems of soil acidity, acid tolerant crops can be grown or lime can be applied to neutralize the soil. It is estimated that more than 2.6 million acres of acid soils in Alberta would benefit from liming (Figure 15).

No potential impacts on other resources have been identified.


HIGH LEVEL
FORT CHIPEWYAN
FORT McMURRAY
PEACE RIVER
GRAY (PEACE)
GRAY (CENTRAL)
GRANDE CACHE
JASPER
NATIONAL
PARK
BANFF
BLACK
LLOYDMINSTER
DARK BROWN
RED DEER
DRUMHELLER
CALGARY
BROWN
MEDICINE HAT
DB
LETHBRIDGE
WATERTON LAKES NATIONAL PARK

Alberta

AGRICULTURAL LAND BASE STUDY
ACID SOIL AREAS IN ALBERTA
(CLI CLASS 1-4)

▨ pH ≤ 6.0 (acid)

☐ pH 6.1-6.5 (potentially acidic)

—— Soil Zones

SOURCE: ALBERTA SOIL AND FEED TESTING LABORATORY, ALBERTA AGRICULTURAL, 1985

PRODUCED BY THE RESOURCE EVALUATION AND PLANNING DIVISION, ALBERTA ENERGY AND NATURAL RESOURCES, 1985

9. SUMMERFALLOW REDUCTION

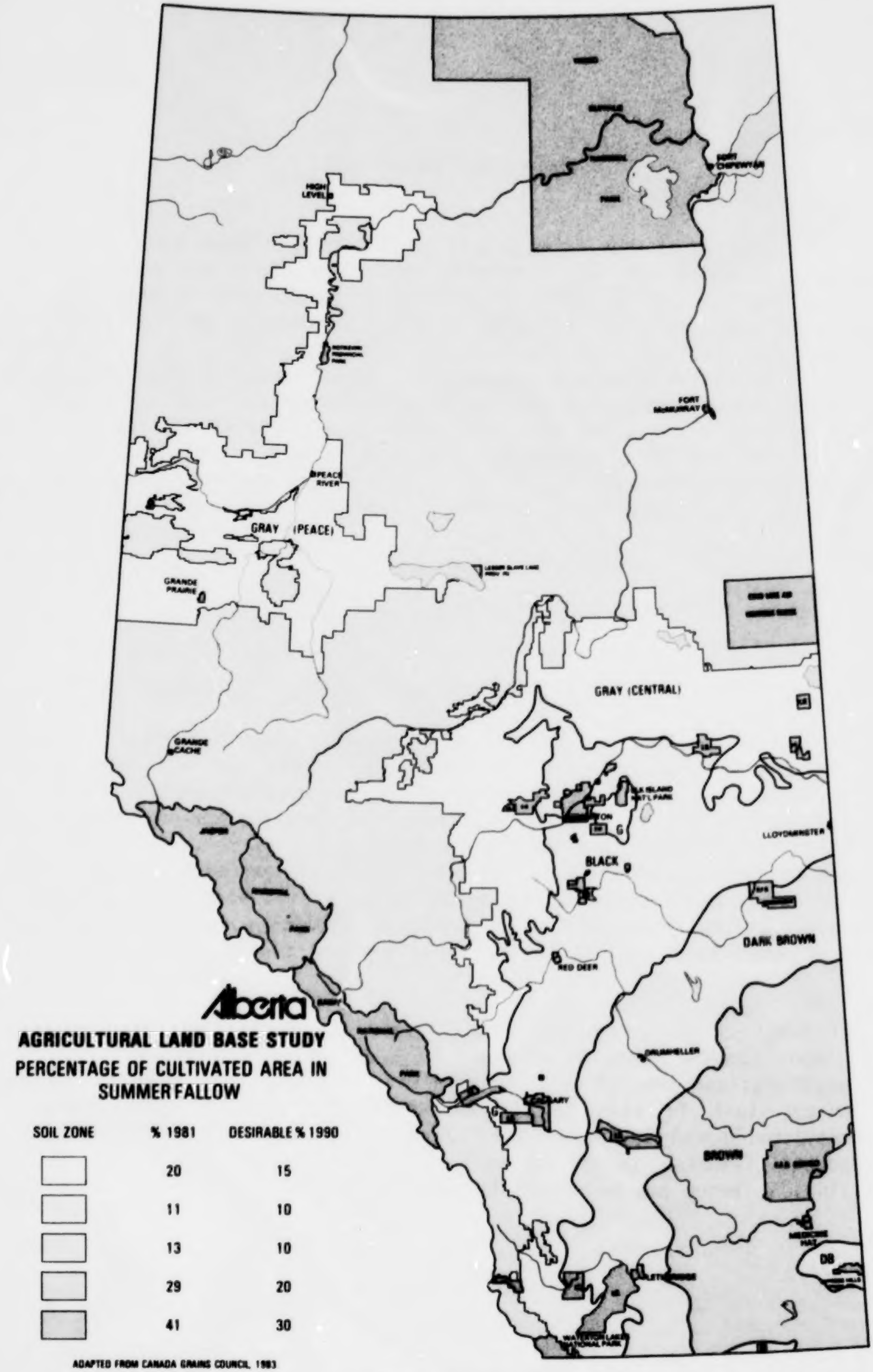
Summerfallow is defined as cultivated land allowed to lie idle during the growing season. The perceived advantages of summerfallowing include increased soil moisture, weed control and nutrient availability. However, summerfallowing can result in problems such as salinity, erosion and loss of organic matter. These problems can be ameliorated by reducing summerfallow acreages. While the practice of summerfallowing may never be totally eliminated, improved stubble seeding, snow trapping, and improved weed control all contribute to reduced summerfallow acreages. In 1981, approximately 5.4 million acres were summerfallowed. It is estimated that by 1990 provincial summerfallow acreage can be reduced by about 25 per cent. This would result in an additional 1.4 million acres being made available for crop production with little or no reduction in average yield (Figure 16).

9.1 Soil Resources

The practice of summerfallowing increases the incidence of wind erosion. For wind erosion to occur soils must be exposed in a condition susceptible to movement and be subjected to winds strong enough to begin soil movement. The velocity at which soil movement begins (threshold velocity) is dependent upon the size of soil particles and the amount of surface protection available (Chepil 1941). Natural vegetative cover or crop residues sharply reduce wind velocity at the soil surface and prevent drifting. Summerfallow has been proven to be more susceptible to wind erosion than cropped fields or pasture.

In 1985, approximately 1.0 million acres of land were affected by serious drifting. This represents approximately 10 per cent of the total cultivated acreage in southeast (Brown and Dark Brown soil zones) Alberta. The majority of this land is likely summerfallow as it is most susceptible to erosion. The reduction of summerfallow acreage for the Brown and Dark Brown soil zones could result in the cropping of an additional .9 million acres annually. If, as with the existing problem, 10 per cent of this land was adversely affected by wind erosion this may reduce the area currently affected by a minimum of 100 000 acres per year.

Measures for preventing wind erosion are based on eliminating the causal factors and protecting the soil from wind. Preventative measures can include, reduction of summerfallow acreage, introduction of zero or minimum tillage practices to provide cover residue as possible, strip farming at right angles to the direction of prevailing winds, establishment of wind breaks, or the returning of highly erodable soils to permanent grasslands (Howitt 1983). Use of proper soil management practices on the farm can control wind erosion just as their absence can increase the risk of damage. Reducing summerfallow acreages contributes to the conservation of soil resources by reducing the risk of wind erosion in southern Alberta.


HIGH LEVEL
FORT CHIPEWYAN
PEACE RIVER
GRAY (PEACE)
GRANDE PRAIRIE
FORT McMURRAY
GRAY (CENTRAL)
GRANDE CACHE
ELK ISLAND NAT'L PARK
G
LLOYDMINSTER
BLACK
DARK BROWN
RED DEER
DRUMHELLER
BROWN
MEDICINE HAT
DB
LETHBRIDGE
WATERTON LAKES NATIONAL PARK

Alberta

AGRICULTURAL LAND BASE STUDY

PERCENTAGE OF CULTIVATED AREA IN SUMMERFALLOW

SOIL ZONE	% 1981	DESIRABLE % 1990
☐	20	15
☐	11	10
☐	13	10
☐	29	20
▨	41	30

ADAPTED FROM CANADA GRAINS COUNCIL, 1983

PRODUCED BY THE RESOURCE EVALUATION AND PLANNING DIVISION, ALBERTA ENERGY AND NATURAL RESOURCES, 1985

10. RANGE IMPROVEMENT

The rangelands of Alberta play a major role in maintaining beef cow herds and producing feeder animals. For the purposes of this study, Range Improvement is defined as breaking and seeding prairie range to tame pasture in southern Alberta; and clearing, breaking, seeding, fertilizing and fencing woodland range to tame pasture in central and northern Alberta. Rangeland improvement offers cattle producers an opportunity to increase production without expanding their land base. There are approximately 11 million acres of CLI class 5 land in the White Area of Alberta. Approximately 20 perx cent or 2.2 million acres may be suitable for Range Improvement considering currently improved acreages, natural limitations and specific refinements (Figure 17).

10.1 Fish and Wildlife Resources

10.1.1 Reduction of the Non-Agricultural Land Base

Prairie Range Improvement would take up non-agricultural land primarily in the Central and Southern administrative regions (Table 10.1). Approximately one half million acres, or 11 per cent of all current non-agricultural land, would be improved in the Central region while 8 per cent of all current non-agricultural land in the Southern region would be improved. As indicated on Table 10.2, Woodland Range Improvement would have a small impact on the current non-agricultural land base of each region. Woodland Range Improvement would, however, still take up almost one quarter of a million acres of land in the Northeast Region.

Prairie Range Improvement would take up non-agricultural land in six habitat regions (Table 10.3). The greatest effects could be realized in the Mixedgrass Prairie and the Montane Habitat Regions which would lose 15 per cent and 14 per cent of their current non-agricultural land base respectively. Woodland Range Improvement would have a relatively small impact on the non-agricultural land base of the Aspen Parkland, Montane, Boreal Mixedwood and Boreal Foothills Habitat Regions (Table 10.4).

Table 10.1

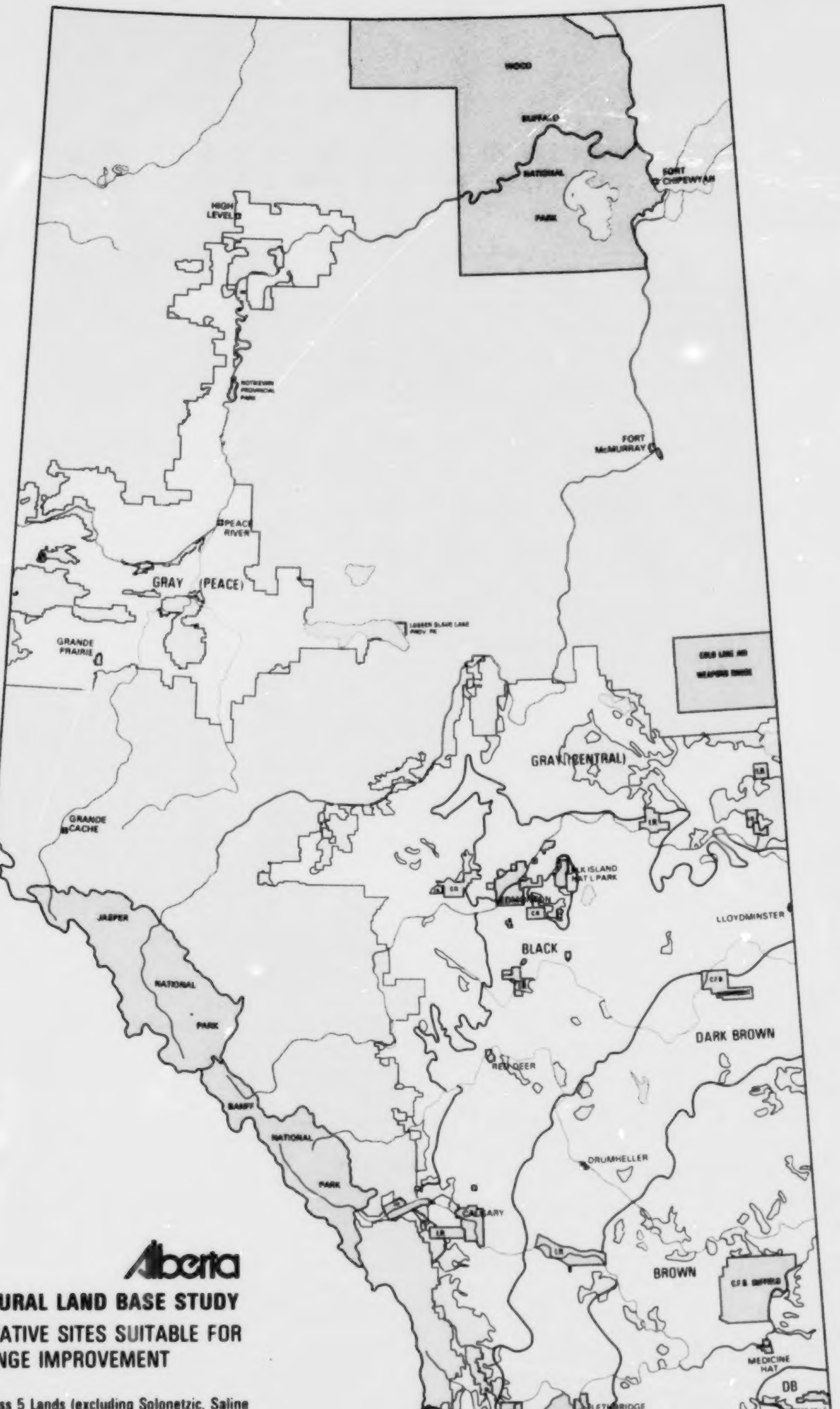
POTENTIAL REDUCTION OF NON-AGRICULTURAL OR UNIMPROVED LAND THROUGH PRAIRIE RANGE IMPROVEMENT BY ADMINISTRATIVE REGION

Administrative Region	Potential Area Affected (000 acres)	Potential Development as Percentage of Non-Agricultural or Predominately Unimproved Land in Each Region
Southern	439	8
Central	559	11
Eastern Slopes	31	<1
Peace River	--	--
Northeast	11	<1
Provincial Total	1 040	1

Table 10.2

POTENTIAL REDUCTION OF NON-AGRICULTURAL OR UNIMPROVED LAND THROUGH WOODLAND RANGE IMPROVEMENT BY ADMINISTRATIVE REGION

Administrative Region	Potential Area Affected (000 acres)	Potential Development as Percentage of Non-Agricultural or Predominantly Unimproved Land in Each Region
Southern	--	--
Central	42	<1
Eastern Slopes	21	<1
Peace River	66	<1
Northeast	242	<1
Provincial Total	371	<1



WOOD
BUFFALO
NATIONAL
PARK
FORT CHIPEWYAN
HIGH LEVEL
FORT McMURRAY
PEACE RIVER
GRAY (PEACE)
LESSER SLAVE LAKE PROV. PK.
GRANDE PRAIRIE
COLD LAKE AIR WEAPONS RANGE
GRAY (CENTRAL)
GRANDE CACHE
ELK ISLAND NAT'L PARK
EDMONTON
LLOYDMINSTER
BLACK
JASPER
NATIONAL
PARK
C.F.B.
DARK BROWN
RED DEER
BANFF
NATIONAL
PARK
DRUMHELLER
CALGARY
I.R.
BROWN
C.F.B. SUFFIELD
MEDICINE HAT
DB
LETHBRIDGE
WATERTON LAKES NATIONAL PARK
DB

Alberta

AGRICULTURAL LAND BASE STUDY

REPRESENTATIVE SITES SUITABLE FOR RANGE IMPROVEMENT

☐ CLI Class 5 Lands (excluding Solonetzic, Saline and Acid Soils)

—— Soil Zones

SOURCE: LAND USE BRANCH, ALBERTA AGRICULTURE, 1985

PRODUCED BY THE RESOURCE EVALUATION AND PLANNING DIVISION, ALBERTA ENERGY AND NATURAL RESOURCES, 1985

Table 10.3

POTENTIAL REDUCTION OF NON-AGRICULTURAL OR UNIMPROVED LAND THROUGH PRAIRIE RANGE IMPROVEMENT BY HABITAT REGION

Habitat Region	Potential Area Affected (000 acres)	Potential Deveopment as Percentage of Non-Agricultural or Predominantly Unimproved Land in Each Region
Shortgrass Prairie	334	6
Mixed Grass Prairie	280	15
Fescue Grasslands	61	8
Aspen Parkland	147	6
Montane	180	14
Subalpine	--	--
Alpine	--	--
Boreal Mixedwood	--	--
Boreal Foothills	38	<1
Boreal Uplands	--	--
Boreal Northlands	--	--
Boreal Subarctic	--	--
Provincial Total	1 040	1

Table 10.4

POTENTIAL REDUCTION OF NON-AGRICULTURAL OR UNIMPROVED LAND THROUGH WOODLAND RANGE IMPROVEMENT BY HABITAT REGION

Habitat Region	Potential Area Affected (000 acres)	Potential Development as Percentage of Non-Agricultural or Unimproved Land in Each Habitat Region
Shortgrass Prairie	--	--
Mixed Grass Prairie	--	--
Fescue Grasslands	--	--
Aspen Parkland	27	1
Montane	3	<1
Subalpine	--	--
Alpine	--	--
Boreal Mixedwood	275	1
Boreal Foothills	66	<1
Boreal Uplands	--	--
Boreal Northlands	--	--
Boreal Subarctic	--	--
Provincial Total	371	<1

10.1.2 Impacts on Wildlife Species in General

Prairie Range Improvement would negatively affect from 42 per cent to 55 per cent of all mammal species found in six habitat regions of the province (Table 10.5). In these habitat regions, 36 per cent to 58 per cent of all resident breeding bird species would be negatively affected. A smaller number of non-breeding bird species would be negatively affected. Of the 37 mammal species in the province that would be negatively affected, 16 species are currently subject to licenced consumptive use. Nineteen of the 93 negatively affected breeding bird species are used consumptively.

Woodland Range Improvement would negatively affect 53 per cent to 69 per cent of all mammal species found in four habitat regions (Table 10.6). Thirty-eight mammal species in the province would be affected and of these, 17 species are used for licenced consumptive purposes. Sixty-two per cent to 73 per cent of all breeding bird species in four habitat regions would be negatively affected by Woodland Range Improvement. Twenty of the 137 negatively affected bird species in the province are used consumptively.

10.1.3 Impacts on the Potential to Produce a Series of Wildlife Species

Prairie Range Improvement would significantly reduce the capability for producing selected ungulate species in the Southern and Central Administrative Regions (Table 10.7). Regional populations of moose and elk would be most affected. Important declines would also occur for mule deer and antelope. Prairie Range Improvement would, however, have a relatively small effect on the provincial potential to produce the above species. Improvement could considerably reduce the amount of class one habitat available for all ungulate species in the Southern and Central regions (Table 10.8). Finally, Prairie Range Improvement would make it more difficult to achieve the provincial population goals for the species listed above (Table 10.9).

Woodland improvement would have a relatively small negative affect on the three ungulate species which were examined (Table 10.10).

10.1.4 Impacts on Fisheries

Section 10.4.1 gives a brief discussion of the mechanisms by which Range Improvement would act to degrade lake, river and stream fisheries.

Table 10.5

MAMMAL AND BIRD SPECIES NEGATIVELY IMPACTED BY PRAIRIE RANGE IMPROVEMENT*

Habitat Region	Mammal Species	Breeding Bird Species	Resident Non-Breeding Bird Species	Migrant Bird Species
Shortgrass Prairie	$\frac{17}{31} = 55\%$	$\frac{71}{123} = 58\%$	$\frac{2}{8} = 25\%$	--
Mixedgrass Prairie	$\frac{13}{26} = 50\%$	$\frac{69}{126} = 55\%$	$\frac{2}{9} = 22\%$	--
Fescue Grasslands	$\frac{11}{20} = 55\%$	$\frac{67}{120} = 56\%$	$\frac{2}{7} = 29\%$	--
Aspen Parkland	$\frac{15}{36} = 42\%$	$\frac{66}{154} = 43\%$	$\frac{2}{9} = 22\%$	--
Montane	$\frac{23}{50} = 46\%$	$\frac{52}{132} = 39\%$	$\frac{0}{2} = 0\%$	--
Boreal Foothills	$\frac{19}{45} = 42\%$	$\frac{51}{143} = 36\%$	$\frac{0}{3} = 0\%$	--
All Others	--	--	--	--
Provincial Total	$\frac{37}{82} = 45\%$	$\frac{93}{245} = 38\%$	$\frac{2}{13^{**}} = 15\%$	$\frac{0}{25} = 0\%$

* Many individual species occur in more than one habitat region.

** Eight resident non-breeding bird species are also counted as breeding bird species in other regions of the province.

Table 10.6

MAMMAL AND BIRD SPECIES NEGATIVELY IMPACTED BY WOODLAND RANGE IMPROVEMENT*

Habitat Region	Mammal Species	Breeding Bird Species	Resident Non-Breeding Bird Species	Migrant Bird Species
Aspen Parkland	$\frac{19}{36} = 53\%$	$\frac{95}{154} = 62\%$	$\frac{4}{9} = 44\%$	--
Montane	$\frac{32}{50} = 64\%$	$\frac{85}{132} = 64\%$	--	--
Boreal Mixedwood	$\frac{30}{45} = 67\%$	$\frac{126}{179} = 70\%$	$\frac{1}{7} = 14\%$	--
Boreal Foothills	$\frac{31}{45} = 69\%$	$\frac{105}{143} = 73\%$	--	--
All Others	--	--	--	--
Provincial Total	$\frac{38}{82} = 46\%$	$\frac{137}{245} = 56\%$	$\frac{4}{13}$** = 31%	$\frac{0}{25} = 0\%$

* Many individual species occur in more than one habitat region.

** Eight resident non-breeding bird species are also counted as breeding bird species in other regions of the province.

Table 10.7

IMPACTS OF PRAIRIE RANGE IMPROVEMENT ON THE CAPABILITY TO PRODUCE SELECTED UNGULATES

Net number of animals lost or gained and percentage change relative to total current potential capability.

	ADMINISTRATIVE REGIONS					
	Southern	Central	Eastern Slopes	Peace River	North-East	Provincial Total
Moose	-900 (-37%)	-1 600 (-47%)	-400 (-1%)	0 (--)	-12 (<-1%)	-2 900 (-2%)
Elk	-900 (-23%)	-1 200 (-57%)	-300 (-1%)	0 (--)	0 (--)	-2 400 (-8%)
White-Tailed Deer	-700 (-5%)	-2 600 (-10%)	0 (--)	0 (--)	-36 (<-1%)	-3 300 (-3%)
Mule Deer	-3 200 (-15%)	-6 400 (-20%)	-400 (-1%)	0 (--)	-40 (<-1%)	-10 100 (-7%)
Antelope	-1 400 (-9%)	-1 400 (-21%)	0 (--)	0 (--)	0 (--)	-2 800 (-13%)

Table 10.8

IMPACTS OF PRAIRIE RANGE IMPROVEMENT ON HABITAT FOR SELECTED UNGULATE SPECIES

Net change in the amount of available habitat (000 acres) and percentage change relative to total current habitat.

	ADMINISTRATIVE REGIONS									
HABITAT SUITABILITY CLASS	MOOSE		ELK		WHITE-TAILED DEER		MULE DEER		ANTELOPE	
	Southern	Central	Southern	Central	Southern	Central	Southern	Central	Southern	Central
1	-265 (-57%)	-349 (-91%)	-355 (-30%)	-350 (-83%)	-235 (-19%)	-66 (-2%)	-647 (-23%)	-1 569 (-44%)	-1 313 (-23%)	-148 (-51%)
2	+256 (+413%)	+307 (+61%)	+319 (+5919%)	-162 (-17%)	+202 (+9%)	-1 908 (-33%)	-266 (-8%)	+462 (+7%)	+975 (+40%)	-1 044 (-23%)
3	+1 (+2%)	-959 (-56%)	-226 (-18%)	+469 (+650%)	-99 (-1%)	+1 908 (+23%)	+913 (+14%)	+1 107 (+16%)	+287 (+20%)	+324 (+14%)
4	+8 (<+1%)	+1 002 (+7%)	+262 (+3%)	+43 (<+1%)	+131 increase is from zero	+66 increase is from zero	0 (--)	0 (--)	+51 (+2%)	+867 (+8%)

* Refer to the following Tables for densities to be expected with each class: Moose (Table 4.5), Elk (Table 4.6), White-Tailed Deer (Table 4.7), Mule Deer (Table 4.8), Antelope (Table 11.5).

Table 10.9

CHANGES IN PRODUCTION CAPABILITY FOR SELECTED UNGULATES, RESULTING FROM PRAIRIE RANGE IMPROVEMENT, IN RELATION TO THE "FISH AND WILDLIFE STATUS REPORT".

MOOSE:

Current Actual Population = 118 000
Actual Population Following Conversion = 115 755
Status Report Goal = 150 000

ELK:

Current Actual Population = 15 000
Actual Population Following Conversion = 13 879
Status Report Goal = 30 000

WHITE-TAILED DEER:

Current Actual Population = 118 000
Actual Population Following Conversion = 111 127
Status Report Goal = 125 000

MULE DEER:

Current Actual Population = 73 000
Actual Population Following Conversion = 67 936
Status Report Goal = 100 000

ANTELOPE:

Current Actual Population = 15 000
Actual Population Following Conversion = 13 089
Status Report Goal = 18 000

See Table 10.9 for an example of how these numbers were calculated.

Table 10.10

IMPACTS OF WOODLAND RANGE IMPROVEMENT ON THE CAPABILITY TO PRODUCE SELECTED UNGULATES

Net number of animals lost or gained and percentage change relative to total current potential capability.

	ADMINISTRATIVE REGIONS					
UNGULATES	Southern	Central	Eastern Slopes	Peace River	North-East	Provincial Total
Moose	0 (--)	-200 (-6%)	-600 (-1%)	-300 (<1%)	-1 100 (-2%)	-2 200 (-1%)
White-Tailed Deer	0 (--)	-35 (<-1%)	-16 (<-1%)	0 (--)	-700 (-1%)	-700 (-1%)
Mule Deer	0 (--)	-100 (<-1%)	-31 (<-1%)	-11 (<-1%)	-300 (-1%)	-400 (<-1%)

10.1.5 General Considerations

Prairie Range Improvement would have a significant negative affect on the regional populations of many wildlife species in southern and central Alberta. In many cases these population declines would be disproportionately high relative to the area of land to be improved for agriculture. For example, as indicated in Table 10.1, prairie improvement would take up only eight per cent of all current non-agricultural land in the Southern administrative region and 11 per cent of all such land in the Central administrative region. However, as shown on Table 10.5, with the exception of antelope in the Southern region and white-tailed deer in both regions, the regional populations of all ungulate species would show declines exceeding eight or 11 per cent. Other wildlife species, which utilize specific habitat types similar to those used by the ungulates on Table 10.7, would likely show similar disproportionate population declines.

It is estimated that Woodland Range Improvement would have a relatively small impact on wildlife populations at a regional and provincial scale, even though this treatment would take up nearly 0.25 million acres in the Northeast Administrative Region. As indicated on Table 10.4, Woodland Range Improvement would have a negative effect on the populations of most bird and mammal species. These negative impacts would tend to reduce the availability of wildlife for human use in various portions of the province at a local scale.

10.2 Timber Resources

Woodland Range Improvement may have an impact on the Community Farm Woodlot (CFW) program of the Alberta Forest Service. As described in the Agricultural Inventory, it was assumed that 25 per cent of the total area suitable for improvement could be removed from the CFW land base. Timber volumes for each CFW are not available, so the analysis was confined to area estimates of impacts (Table 10.11). In most cases the effect of Range Improvement on CFWs is quite small but could affect up to 25 per cent of several developed woodlots. This could result in some locally important consequences.

10.3 Public Rangeland Resources

There are approximately 1.5 million acres of CLI Class 5 public land in the White Area, or about 21 per cent of public rangelands excluding the Special Areas, that is currently disposed to grazing (Table 10.12). Approximately 20 to 25 per cent of this land is suitable for improvement, which would therefore result in an increase of AUMs. Many range specialists feel that in dryland areas of southern Alberta, Range Improvement is only practical to restore degraded native grazing or to provide spring pasture. It is also felt that well managed native range may be the most productive in the long term. Therefore, actual cattle numbers would not tend to increase in these areas. The actual number of cattle increases would be dependent on the grazing season and management considerations.

The maximum increase in grazing capacity that might be realized through the Range Improvement alternative is about 12 per cent of the current provincial AUM total. The Southern Region contains most of the CLI Class 5 public rangelands (825 000 acres) but the response of this land to improvement is relatively small compared to the Central-Eastern Slopes and Northeast Regions (Table 10.12). The largest increase in AUMs would occur in the Northeast Region where over 100 000 AUMs would be gained.

Table 10.11

PERCENT OF EXISTING AND PROPOSED COMMUNITY FARM
WOODLOTS AFFECTED BY WOODLAND RANGE IMPROVEMENT

Existing Woodlot	% of Area	Proposed	% of Area
Child Lake	5	Edson	20
Tompkins	15	Chip Lake	15
Hawk Hills	5		
Weberville	25		
Hines Creek	20		
Worsley	10		
Puskwaska	25		
McLennan	15		
Snipe Lake	15		
Enilda	20		
DS4-S02-2351	25		
Sturgeon Lake Area	15		
Whitecourt	25		
Edson	15		

10.4 Water resources

10.4.1 Water Quality

The major information source used in this review is a study conducted by the Pollution Control Dibision of Alberta Environment on phosphorus export from the Majeau Creek watershed near Lac La Nonne (Mitchell and Hamilton 1982). This study sampled runoff from a number of agricultural watersheds and compared nutrient levels in the runoff with the number of livestock in the watershed. The results indicate that the export of total phosphorous is proportional to the concentration of cattle in the watershed, and that phosphorus loadings are considerably higher in grazed watersheds than in mixed forest/light agricultural watersheds. In the Lac La Nonne watershed these increased phosphorus loadings have resulted in the accelerated deterioration of the lake, which is now classified as highly eutrophic.

Table 10.12

REGIONAL SUMMARIES OF RANGE IMPROVEMENT IMPACTS ON GRAZING OF PUBLIC LAND IN THE WHITE AREA (EXCLUDING THE SPECIAL AREAS)

E & NR Region	Current Grazing on CLI 5 Public Land in the White Area (000 acres)	AUMs Gained if 20 to 25% of CLI 5 Land is Improved
Southern	825	61 700
Central-Eastern Slopes	160	47 600
North East	500	103 400
Peace River	56	11 900
TOTAL AFFECTED	1 541	224 600
Provincial Total in the White Area	7 287	1 874 000
% of Total in the White Area	21%	12%

Similar impacts are likely to occur in any area where range improvements are carried out, and if animals are grazed at the concentrations proposed in the inventory report, these impacts may be even more severe than those experienced at Lac La Nonne. In the Lac La Nonne area the highest livestock concentration measured was 1.66 animals/acre producing a phosphorus export of 3.5 kg/acre year. This loading compares with an average of 1.2 kg/acre/year for mixed agricultural watersheds, and 0.3 kg/acre/year from forested watersheds. The inventory proposes stocking rates of 2.4 to 12.2 animals/acre which if applied to only 25 per cent of a watershed could still amount to a concentration of 3.1 animals/acre. At these levels the phosphorus loading produced would lead to extremely high concentrations of algae, which can cause summer and winter kill of fish, and would severely limit use of these waters.

The extent of effects is largely dependent on the location of the lands suitable for improvement. In both the Prairie and Woodland Range Improvement alternatives a number of areas can be identified where consequences may be concentrated.

Prairie Range Improvement -- Prairie Range Improvement may produce significant water quality effects in two major areas: the foothills southwest of Calgary and the lower Red Deer basin.

The foothills region forms part of the headwaters of the Bow and Oldman rivers and is therefore an important source of surface run-off. Potential pollutants in this area could have widespread effects. Increased nutrient inputs into these rivers would likely occur if these lands were improved and cattle numbers increase, however, whether this increased loading would lead to deterioration in water quality is impossible to predict. It appears that these streams may be able to assimilate these wastes since current water quality is good and other factors such as water temperature, and a limited supply of other plant nutrients may preclude major eutrophication problems.

In the lower Red Deer basin impacts may be more severe since lower reaches of the Red Deer currently experience weed and algae growth related to high nutrient levels and further loadings could intensify this problem. Much of the area outlined is close to the river and its tributaries, and if large areas were improved some degradation in river quality would be expected, particularly during low flows.

Woodland Range Improvement -- Three areas of concern exist from Woodland Range Improvement. These are: the Lake Wabamun watershed, the Cooking Lake area, and the Beaver River basin.

In the Lake Wabamun case a large area southwest of the lake is identified as suitable for improvement. This area drains directly into the lake and if used for improved grazing could significantly increase nutrient loadings to the lake. Lake Wabamun is one of the most heavily used recreational lakes in Alberta and, according to many of its long time residents, the lake's water quality is deteriorating. A study conducted by the Pollution Control Division of Alberta Environment (Mitchell 1981) concluded that the lake is approaching eutrophic conditions and that the limiting nutrient for plant growth in the lake is phosphorus. These results indicate that any increase in phosphorus loading to the lake will accelerate the eutrophication process and should be avoided if possible.

Similar concerns exist in the Cooking Lake area which was once the subject of an intensive Alberta Environment study (Alberta Environment 1976). The study indicates that although current water quality is not particularly good, the lakes would be very sensitive to any land use changes in their watersheds. The development of the area outlined for improvement in the Woodland Range option would involve grazing animals in large portions of the watersheds of Cooking, Ministik, Oliver, Hastings, Joseph, Oliver and Miquelon lakes and would likely lead to further water quality deterioration in all of these lakes.

The Beaver River Basin has also been the subject of considerable study by Alberta Environment (Alberta Environment 1985b)). Water quality criteria have been set at the Saskatchewan border by the Prairie Provinces Water Board and have included limits for phosphorus loading in the river. The Prairie Range Improvement option identifies 200 000 acres of rangeland in the basin. Development could lead to a potential increase in phosphorus loading of 53 per cent. If this development were carried out over a 20 year period, along with predicted municipal and industrial development, the predicted phosphorus loading would be almost twice the criteria level, as compared to only a 15 per cent exceedance with only municipal/industrial development.

11. PRAIRIE RANGE CONVERSION

Rangeland accounts for a significant portion of southern Alberta's agricultural land base. A portion of the White Area land base currently used as pasture has the capability (CLI 1-4 land) of producing field crops. Prairie Rangeland Conversion is defined as breaking and seeding prairie range for the production of annual field crops. It is estimated that approximately 3.6 million acres of the CLI class 1-4 lands in southern Alberta have a potential for range conversion (Figure 18).

11.1 Fish and Wildlife Resources

11.1.1 Reduction of The Non-Agricultural Land Base

Prairie Range Conversion would have a significant impact on the land base of two administrative regions (Table 11.1). Conversion would take up 38 per cent of all current non-cultivated land in the southern administrative region and 24 per cent of all such land in the central administrative region. Only 3 per cent of all non-cultivated land in the province would be lost.

Conversion would significantly impact four habitat regions (Table 11.2). Twenty-eight per cent of all non-cultivated land in the Short Grass Prairie and 29 per cent of all such land in the Aspen Parkland would be lost. Non-cultivated land in the Mixed Grass Prairie (-36 per cent) and the Fescue Grasslands (-60 per cent) would be impacted to a greater extent by conversion.

11.1.2 Impacts on Wildlife Species in General

As indicated on Table 11.3, Prairie Range Conversion would negatively affect the majority of all mammal species found in four habitat regions. Between 64 per cent and 75 per cent of all mammal species found in the Short Grass Prairie, Mixed Grass Prairie, Fescue Grasslands and Aspen Parkland could be affected. A negative effect would occur for 36 per cent and 38 per cent of all mammal species in the Boreal Boothills and Montane regions respectively. All of the 37 species in the province that would be negatively affected have some non-consumptive value, while 16 of the 37 are subject to licensed consumptive use.

Table 11.1

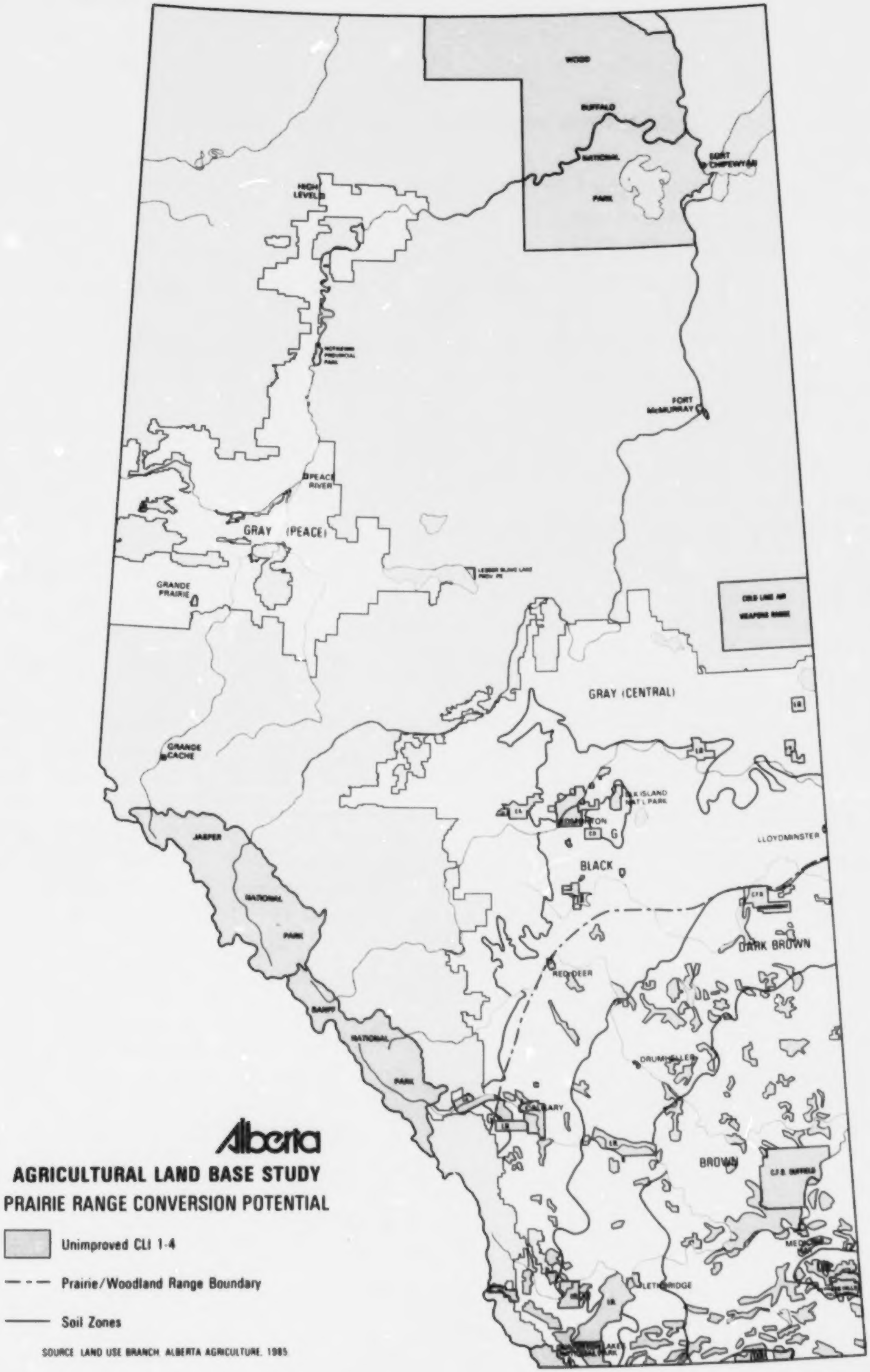
POTENTIAL REDUCTION OF NON-AGRICULTURAL OR UNIMPROVED LAND THROUGH PRAIRIE RANGE CONVERSION BY ADMINISTRATIVE REGION

Administrative Region	Potential Development (000 acres)	Potential Development as Percentage of Non-Agricultural Land in Each Region
Southern	2 199	38
Central	1 270	24
Eastern Slopes	8	<1
Peace River	--	--
Northeast	123	<1
Provincial Total	3 600	3

Table 11.2

POTENTIAL REDUCTION OF NON-AGRICULTURAL OR PREDOMINANTLY UNIMPROVED LAND THROUGH PRAIRIE RANGE CONVERSION BY HABITAT REGION

Habitat Region	Potential Development (000 acres)	Potential Development as Percentage of Non-Agricultural Land in Each Region
Shortgrass Prairie	1 608	28
Mixed Grass Prairie	667	36
Fescue Grasslands	454	60
Aspen Parkland	749	29
Montane	90	7
Subalpine	---	--
Alpine	---	--
Boreal Mixedwood	---	--
Boreal Foothills	32	<1
Boreal Uplands	---	--
Boreal Northlands	---	--
Boreal Subarctic	---	--
Provincial Total	3 600	3


WOOD
BUFFALO
NATIONAL
PARK
FORT CHIPEWYAN
HIGH LEVEL
FORT McMURRAY
PEACE RIVER
GRAY (PEACE)
LESSER SLAVE LAKE PROV. PK
GRANDE PRAIRIE
COLD LAKE AIR WEAPONS RANGE
GRAY (CENTRAL)
IR
GRANDE CACHE
ELK ISLAND NAT'L PARK
EDMONTON
G
LLOYDMINSTER
BLACK
JASPER
NATIONAL
PARK
CFB
DARK BROWN
RED DEER
BANFF
NATIONAL
PARK
DRUMHELLER
CALGARY
IR
BROWN
C.F.B. SUFFIELD
MEDICINE HAT
LETHBRIDGE
IR
WATERTON LAKES NATIONAL PARK

Alberta

AGRICULTURAL LAND BASE STUDY

PRAIRIE RANGE CONVERSION POTENTIAL

▨ Unimproved CLI 1-4

— - — Prairie/Woodland Range Boundary

—— Soil Zones

SOURCE: LAND USE BRANCH, ALBERTA AGRICULTURE, 1985

PRODUCED BY THE RESOURCE EVALUATION AND PLANNING DIVISION, ALBERTA ENERGY AND NATURAL RESOURCES, 1985

Table 11.3

MAMMAL AND BIRD SPECIES NEGATIVELY IMPACTED BY PRAIRIE RANGE CONVERSION*

Habitat Region	Mammal Species	Breeding Bird Species	Resident Non-Breeding Bird Species	Migrant Bird Species
Shortgrass Prairie	$\frac{20}{31} = 65\%$	$\frac{79}{123} = 64\%$	--	--
Mixedgrass Prairie	$\frac{17}{26} = 65\%$	$\frac{79}{126} = 63\%$	--	--
Fescue Grasslands	$\frac{15}{20} = 75\%$	$\frac{77}{120} = 64\%$	--	--
Aspen Parkland	$\frac{23}{36} = 64\%$	$\frac{70}{154} = 45\%$	--	--
Montane	$\frac{19}{50} = 38\%$	$\frac{41}{132} = 31\%$	--	--
Boreal Foothills	$\frac{16}{45} = 36\%$	$\frac{49}{143} = 34\%$	--	--
All Others	--	--	--	--
Provincial Total	$\frac{37}{82} = 45\%$	$\frac{90}{245} = 37\%$	$\frac{0}{13^{**}} = 0\%$	$\frac{0}{25} = 0\%$

* Many individual species occur in more than one habitat region.

** Eight Resident non-breeding bird species are also counted as breeding bird species in other regions of the province.

Approximately 64 percent of all breeding bird species in the Short Grass Prairie, Mixed Grass Prairie and Fescue Grasslands would be reduced as a result of conversion (Table 11.3). Forty-five per cent of Aspen Parkland breeding bird species would be negatively affected while a somewhat smaller impact would occur for Montane (31 per cent affected), and Boreal Foothills (34 per cent affected) species. Conversion would reduce populations of 90 breeding bird species in the province. Seventeen of these 90 species are used consumptively while all of the 90 are used non-consumptively.

11.1.3 Impacts on the Potential to Produce a Series of Wildlife Species

The provincial capability for pronghorn antelope production would decline by approximately 24 per cent with Prairie Range Conversion (Table 11.4). Similarly the regional capability of both the southern and central region would decline by 24 per cent. As indicated on Table 11.5, a reduction in the availability of productive antelope habitat would occur in both the central and southern regions. In both of these regions a major increase would occur in the area of poor quality habitat.

The regional capability for mule deer production would decline in both the southern (-33 per cent) and central (-15 per cent) administrative regions (Table 11.4). The provincial capability would only be reduced by 9 per cent. Good and intermediate quality habitat would decline in both the southern and central regions (Table 11.6). This decline would be especially pronounced in the southern region.

The impact of Prairie Range Conversion on white-tailed deer would be somewhat greater than the effects of conversion on mule deer (Table 11.4). This likely would occur since mule deer would continue to use very rough land which are unsuitable for conversion. In contrast, conversion would take up land to which white-tailed deer are best adapted. The regional potential for white-tailed deer would decline by 43 per cent in the southern region and 20 per cent in the central region. A 10 per cent reduction in provincial capability would occur. In both the Southern and Central Regions, the availability of class 1 and class 2 white-tailed deer habitat would substantially decline as a result of conversion (Table 11.7). Much of the remaining area of these regions would maintain white-tailed deer at very low densities.

It should be noted that the decline in habitat quality for all three ungulate species will likely result in an increased occurrence of depredation by these species on agricultural land. As indicated in Table 11.8, following Prairie Range Conversion it would be difficult to achieve the provincial population goals for the three ungulate species discussed above. This effect would be most serious for white-tailed deer and antelope.

Table 11.4

IMPACTS OF PRAIRIE RANGE CONVERSION ON THE CAPABILITY TO PRODUCE SELECTED UNGULATES

Net number of animals lost or gained and percentage change relative to total current potential capability.

ADMINISTRATIVE REGIONS						
	Southern	Central	Eastern Slopes	Peace River	North-east	Provincial Total
Antelope	-3 700 (-24%)	-1 700 (-24%)	0 (--)	0 (--)	0 (--)	-5 300 (-24%)
White-Tailed Deer	-5 400 (-43%)	-5 500 (-20%)	-23 (less than 1%)	0 (--)	-400 (-1%)	-11 400 (-10%)
Mule Deer	-7 300 (-33%)	-4 900 (-15%)	-25 (less than 1%)	0 (--)	-400 (-1%)	-12 600 (-9%)

Table 11.5

IMPACTS OF PRAIRIE RANGE CONVERSION ON ANTELOPE HABITAT

Net change in the amount of available habitat (000 acres) and the percentage change relative to total current habitat.

HABITAT SUITABILITY CLASS	ADMINISTRATIVE REGIONS					
	Southern	Central	Eastern Slopes	Peace River	North-East	Provincial Total
1 (2.0 antelope /1000 acres	-2 227 (-39%)	-40 (-14%)	0 (--)	0 (--)	0 (--)	-2 267 (-38%)
2 (1.2 antelope /1000 acres	-24 (-1%)	-1 693 (-38%)	0 (--)	0 (--)	0 (--)	-1 717 (-25%)
3 (0.4 antelope /1000 acres	+2 178 (+149%)	+1 169 (+50%)	0 (--)	0 (--)	0 (--)	+3 349 (+88%)
4 (0.0 antelope /1000 acres	+72 (+2%)	+564 (+5%)	0 (--)	0 (--)	0 (--)	+636 (+1%)

Table 11.6

IMPACTS OF PRAIRIE RANGE CONVERSION ON MULE DEER HABITAT

Net change in the amount of available habitat (000 acres) and the percentage change relative to total current habitat.

HABITAT SUITABILITY CLASS	ADMINISTRATIVE REGIONS					
	Southern	Central	Eastern Slopes	Peace River	North-East	Provincial Total
1 (4.9 deer/ 1000 acres)	-1 042 (-36%)	-503 (-14%)	0 (--)	0 (--)	-99 (-6%)	-1 642 (-16%)
2 (1.6 deer/ 1000 acres)	-1 504 (-45%)	-2 069 (-30%)	-19 (less than -1%)	0 (--)	-22 (less than -2%)	-3 614 (-9%)
3 (0.4 deer/ 1000 acres)	+508 (+8%)	+2 314 (+32%)	+19 (+1%)	0 (--)	+121 (+1%)	+2 963 (+4%)
4 (0.0 deer/ 1000 acres)	+2 038 increase is from zero	+257 increase is from zero	0 (--)	0 (--)	0 (--)	+2 295 (+9%)

Table 11.7

IMPACTS OF PRAIRIE RANGE CONVERSION ON WHITE-TAILED DEER HABITAT

Net change in the amount of available habitat (000 acres) and the percentage change relative to total current habitat.

HABITAT SUITABILITY CLASS	ADMINISTRATIVE REGIONS					
	Southern	Central	Eastern Slopes	Peace River	North-East	Provincial Total
1 (4.0 deer/ 1000 acres)	-833 (-67%)	-1 051 (-30%)	0 (--)	0 (--)	-122 (-1%)	-2 005 (-14%)
2 (1.6 deer/ 1000 acres)	-660 (-29%)	-1 233 (-22%)	-18 (-1%)	0 (--)	0 (--)	-1 911 (-10%)
3 (0.4 deer/ 1000 acres)	-723 (-8%)	+1 802 (+22%)	+18 less than +1%)	0 (--)	+122 (+1%)	+1 220 (+2%)
4 (0.0 deer/ 1000 acres)	+2 215 increase is from zero	+481 increase is from zero	0 (--)	0 (--)	0 (--)	+2 696 (+6%)

Table 11.8

CHANGES IN PRODUCTION CAPABILITY FOR SELECTED UNGULATES, RESULTING FROM PRAIRIE RANGE CONVERSION, IN RELATION TO THE "FISH AND WILDLIFE STATUS REPORT".

ANTELOPE:

Current Actual Population = 15 000
Actual Population Following Conversion= 11 300
Status Report Goal = 18 000

MULE DEER:

Current Actual Population = 73 000
Actual Population Following Conversion= 66 600
Status Report Goal = 100 000

WHITE-TAILED DEER:

Current Actual Population = 118 000
Actual Population Following Conversion= 103 000
Status Report Goal = 125 000

Footnote: See Table 4.9 for an example of how these numbers have been calculated.

Table 11.9

THE IMPACT OF PRAIRIE RANGE CONVERSION ON SAGE GROUSE HABITAT (000 acres)

Total area of habitat subregions where sage grouse are present.	2 193
Total area of above which currently is unimproved for agriculture.	1 333
Total area of unimproved sage grouse habitat potentially suitable for Prairie Range Conversion.	475
Percentage of habitat affected.	36%

11.1.4 Consequences for Certain Vulnerable Wildlife Species

Table 11.9 indicates the extent to which conversion would impact habitat currently used by sage grouse. In Alberta this species is found exclusively in the Shortgrass Prairie habitat region. Agricultural activities are typically quite detrimental to the quality of sage grouse habitat (Nietfeld et al. 1984). Table 11.9 was prepared by first summarizing the total area of all habitat subregions within which sage grouse are found. Within these subregions the amount of current non-cultivated land was measured and then compared to the identified potential for range conversion. Prairie Range Conversion would likely destroy at least 36 per cent of all current sage grouse habitat in the province.

11.1.5 Effects on Trapping

Table 11.10 indicates the extent to which conversion would negatively affect resident trapping activities. Resident trappers are licenced to trap on lands not covered by a registered trapping area. Data estimating the per cent decline in number of trappers were determined by first calculating the per cent decline of all non-agricultural land found in each Fish and Wildlife Division district of the province. The total revenue generated by certain furbearers in each district was then decreased by the same per cent decline. This last calculation was only conducted for furbearers which would obviously be negatively affected by the loss of non-agricultural land through conversion. Finally, the loss of trappers was estimated by dividing the total calculated lost revenue for each district by the average yearly income for trappers in that district. These results were summarized by administrative region.

Prairie Range Conversion would result in the loss of eight per cent of all resident trappers in the province. The greatest regional declines would occur in the southern (28 per cent decline) and central regions (18 per cent decline).

11.1.6 Effect on Fisheries

Section 11.3.2 indicates some of the mechanisms by which Prairie Range Conversion could act to negatively affect fish populations. As with Green Area Expansion, Prairie Range Conversion would reduce or eliminate fish populations by altering stream and river flow conditions, by increasing sediment loads in streams, rivers and lakes and by increasing nutrient loads in streams, rivers and lakes.

Table 11.10

THE IMPACT OF PRAIRIE RANGE CONVERSION ON RESIDENT TRAPPING ACTIVITY

	ADMINISTRATIVE REGION					
	Southern	Central	Eastern Slopes	Peace River	North-East	Provincial Total
Total Current Number of Trappers	342	792	188	494	1 454	3 270
Percent of Total Trappers Lost as a Result of Conversion	28%	18%	1%	0%	2%	8%

Table 11.11 gives an estimate of the number and area of fish bearing lakes in the province that would be negatively affected to some degree by Prairie Range Conversion. Conversion would affect a rather small proportion of all lakes in the province. Conversion could occur within the drainage basins of nine per cent of the total number of fish bearing lakes in Alberta. Only three per cent of the total area of all fish bearing lakes in the province would be affected. However, a sustantial regional impact would occur in the southern region where 88 per cent of the total area of all fish bearing lakes could be affected to some degree.

No estimate was made as to how many fish bearing streams and rivers would be negatively affected by Prairie Range Conversion. Most negative effects would occur for watercourses in the central and especially the southern administrative regions.

11.1.7 General Considerations

In general, Prairie Range Conversion would reduce the diversity and abundance of wildlife in southern and central Alberta. Conversion would likely act to reduce wildlife populations in three ways. First, conversion would tend to reduce the diversity of habitats in a given area. Many species in southern Alberta currently are dependent on a mix of two or more specific habitat types. Second, Prairie Range Conversion would take up the native Short and Mixed Grass range land to which many "typical prairie species" are adapted. It should be noted that, unlike many woodland species, most prairie species have a restricted distribution in Alberta. They are found only in the portion of the province that is being evaluated for Prairie Range Conversion potential. Finally, conversion would reduce the availability of wooded and bushy areas in the prairie habitat regions and in the southern portion of the Aspen Parkland. The presence of these wooded areas permits certain "woodland species" to inhabit the southern and central portions of the province.

The effects of Prairie Range Conversion would primarily be realized in the central and especially in the southern administrative regions of the prov- ince. Opportunities for the consumptive and non-consumptive use of wild- life would decline in these regions following conversion.

11.2 Public Rangeland Resources

The Prairie Range Conversion alternative could impact 455 000 acres (Table 11.12) of public land in the White Area (not including the Special Areas). This is about six per cent of the total public rangeland in the White Area. Approximately 110 000 AUMs, or six per cent of the provincial total, could be lost through Prairie Range Conversion. The severity of these losses depends on whether large blocks of land were converted or small scattered units were converted. Impacts would be less severe if scattered units were affected. As with other alternatives that affect public rangelands, the most important effects could be on traditional lifestyles of ranching.

The area of land potentially impacted by conversion on Provincial Grazing Reserves is summarized in Table 11.13. Approximately one-half of Provincial Grazing Reserves are located on CLI 1-4 land, which correspond to about 105 000 AUMs which also is about one-half of the provincial total carrying capacity. The conversion of such large portions of grazing reserves would have an obvious severe impact on the Provincial Grazing Reserve program. Much of the CLI 1-4 land on these reserves is not suitable for field crops, as it is mostly class 4 found in complex units with non-arable land, or for other reasons. For the purpose of this study these lands are considered arable.

Table 11.11

IMPACT OF PRAIRIE RANGE CONVERSION ON KNOWN FISH BEARING LAKES BY ADMINISTRATIVE REGION

Administrative Region	Percent of total number and percent of total area (acres) of all fish-bearing lakes in each region, which have some potential for range conversion within their basins.
Southern	Number = $\frac{47}{73}$ = 64% Area = $\frac{92\ 120}{104\ 379}$ = 88%
Central	Number = $\frac{21}{75}$ = 28% Area = $\frac{32\ 886}{112\ 745}$ = 29%
Eastern Slopes	Number = $\frac{5}{186}$ = 3% Area = $\frac{30}{83\ 593}$ = <1%
Peace River	Number = $\frac{0}{139}$ = 0% Area = $\frac{0}{777\ 366}$ = 0%
Northeast	Number = $\frac{2}{330}$ = 1% Area = $\frac{242}{2\ 710\ 576}$ = <1%
Provincial Total	Number = $\frac{75}{803}$ = 9% Area = $\frac{125\ 276}{3\ 788\ 658}$ = 3%

Table 11.12

REGIONAL SUMMARIES OF PRAIRIE RANGE CONVERSION IMPACTS ON GRAZING ON PUBLIC LAND IN THE WHITE AREA (EXCLUDING THE SPECIAL AREAS)

ENR Region	Areas CLI 1-4 currently disposed to grazing (000 acres)	AUMs potentially lost on CLI 1-4
Southern	425	101 000
Central-Eastern Slopes	30	9 000
TOTALS AFFECTED	455	110 000
Provincial Totals	7 287	1 874 000
Percentage of Provincial Totals	6%	6%

Table 11.13

IMPACTS OF CONVERTING POTENTIALLY ARABLE LAND IN PROVINCIAL GRAZING RESERVES

Region	Soil Zone	Area (000 acres)	AUMs potentially lost
Southern: Pinhorn, Twin River, Purple Springs, Bow Island, Seven Persons Hays	Brown	85	17 000
Central: Buck Mountain	Central Gray	10	5 000
Northeast: Minburn, Jackpine, Connor Creek, St. Paul/ Rannach, Thorhild	Central Gray (Minburn is in the Black)	105	52 000
Peace River: Manning, Fort Vermilion, Valleyview, Kleskun, High Prairie, Wanham, Blueberry Mountain, Bear Canyon, Whitemud, Three Creeks	Peace River Gray	157	31 400
TOTAL OF AFFECTED RESERVES		357	105 400
PROVINCIAL TOTAL AREA AND AUMs ON ALL RESERVES		706	224 400
PERCENTAGE OF PROVINCIAL TOTAL		50	47

11.3 Soil Resources

11.3.1 Erosion by Wind

Southeastern Alberta is considered to be within the Palliser Triangle, an area once described as being unfit for cultivation. At the turn of the century, as large numbers of settlers began to enter the area, huge tracts of prairie were broken for crop production. High initial yields encouraged the plowing of submarginal lands. Within this area drier weather and stronger winds gave rise to black blizzards of drifting soil which characterized the beginning of the depression (Alberta Agriculture 1980).

The conversion of arable CLI class 1-4 rangelands to field crop production could seriously increase existing wind erosion problems in southeast Alberta. The risk of wind erosion is directly related to physical and climatic conditions within the region and soil management practices adopted by local farmers. The climatic conditions most conducive to wind erosion include high and frequent winds, low precipitation and high evapotranspiration. The winds of southern and southeastern Alberta are substantially stronger than those of the central part of the province (Erdman, R.L. 1942). Chinook winds can be especially damaging because they remove the protective snow cover, while the freeze-drying effects of frost leaves the soil more susceptible to erosion. The Brown and Dark Brown soils of southern Alberta are low in organic matter (2.3 per cent) and therefore contain little binding matter to hold the soil together. Soils with relatively higher amounts of sand or clay are most susceptible to erosion. Farm management practices, especially bare summerfallow which exposes soil to the wind, have a major influence on the extent and severity of wind erosion.

The Conservation and Development Branch of Alberta Agriculture has estimated that if soils can be seen to be blowing -- at least 5 tons of topsoil is being lost per acre. Soil losses of 50 tons per acre or more may be experienced during severe storms. The loss of 50 tons of topsoil is roughly less than one-third of an inch of topsoil per acre. Crop yields may be permanently reduced by approximately 3.4 bushels per acre per year per inch of topsoil lost (Anonymous 1980). More than one million acres of land in southern Alberta experienced serious drifting during the winter and spring of 1985. Some fields in the Lethbridge area may have lost as much as two inches of topsoil (Alberta Agriculture 1985).

The one million acres affected by soil erosion in 1985 represents 10 per cent of the cultivated farmland in the Brown and Dark Brown soil zones. The Prairie Range Conversion development alternative identified an additional 3.5 million acres of potentially arable land as being suitable for field crop production in these areas. Therefore 10 per cent or 350 000 acres of the potentiall arable land may also be susceptible to wind erosion, is a conservative estimate. Without mitigation the Prairie Range Conversion development alternative could increase the existing erosion problem in southern Alberta by 30 per cent.

11.3.2 Erosion by Water

One of the primary impacts associated with breaking rangelands in southern Alberta is the potential for soil erosion when the protective layer of vegetation is removed and the soil is exposed to the erosive effects of water. Approximately 56 per cent of rangelands with potential for conversion are located in the Brown Soil Zone which is sandy in texture, has low organic matter content and therefore is very easily broken down into small, easily erodible particles. The remainder is divided between the Dark Brown and Black soils which are somewhat less susceptible to erosion due to higher organic matter contents and more favourable moisture conditions.

In the Brown Soil Zone the current crop mix is almost entirely a wheat-fallow rotation, a farming system which returns little residue to the soil and increases susceptibility to erosion because of lack of cover. The inventory assumed that rangelands converted to cropland in this zone will be farmed under a similar crop mix, increasing the currently cultivated acreage in the zone by approximately 50 per cent. Much of this area is public or patented land which has not been cultivated due to constraining factors such as topography, low soil moisture, or poor soil structure. All of these factors would tend to increase the risk of erosion by both water and wind. The consequences of increased soil erosion by water in this area would be noticeable in the form of increased sediment and nutrient loads in area streams and rivers. Such increases may have severe implications for water quality in the lower Red Deer and South Saskatchewan rivers.

12. WOODLAND CONVERSION

A large portion of the White Area in north and north-central Alberta is still covered by forest and bush. Some of these woodland areas have a capability (CLI 1-4 land) of producing field crops. Woodland conversion is defined as clearing, breaking and seeding woodland areas to annual field crops. It is estimated that approximately 7.0 million acres of CLI class 1-4 lands have a potential for Woodland Conversion (Figure 19).

12.1 Fish and Wildlife Resources

12.1.1 Reduction of the Non-Agricultural Land Base

Tables 12.1 to 12.4 describe the extent to which Woodland Conversion would reduce the availability of unimproved land in the province. As indicated on these tables, Woodland Conversion would affect two distinct types of unimproved land. First, conversion would improve certain large contiguous areas of currently unimproved land (Tables 12.1 and 12.2) for agriculture. These large unimproved areas, which total approximately 6.2 million acres, are depicted on the Woodland Conversion Potential Map (Figure 18). In addition to this land, conversion would take up approximately nine hundred thousand acres of residual woodlands which are found within areas that are currently improved for agriculture (Tables 12.3 and 12.4). These residual woodlands include such landscapes as hedgerows, small woodlots, rough pastures and the bushy margins of wetlands.

As indicated on Table 12.1, conversion of large parcels of woodland would reduce the amount of non-cultivated land available in all administrative regions with the exception of the Southern Region. Only 6 per cent of all non-cultivated land in the province would be lost. Conversion would, however, significantly reduce the amount of non-cultivated land currently available within the White Area of the province. As indicated on the last column of Table 12.1, 29 per cent of all unimproved land in the White Area would be lost. Significant regional reductions would occur for lands in the White Area of the Eastern Slopes, Peace River and Northeast Regions. This land contains the unimproved woodland areas found in closest proximity to human population centres in the province.

Table 12.1

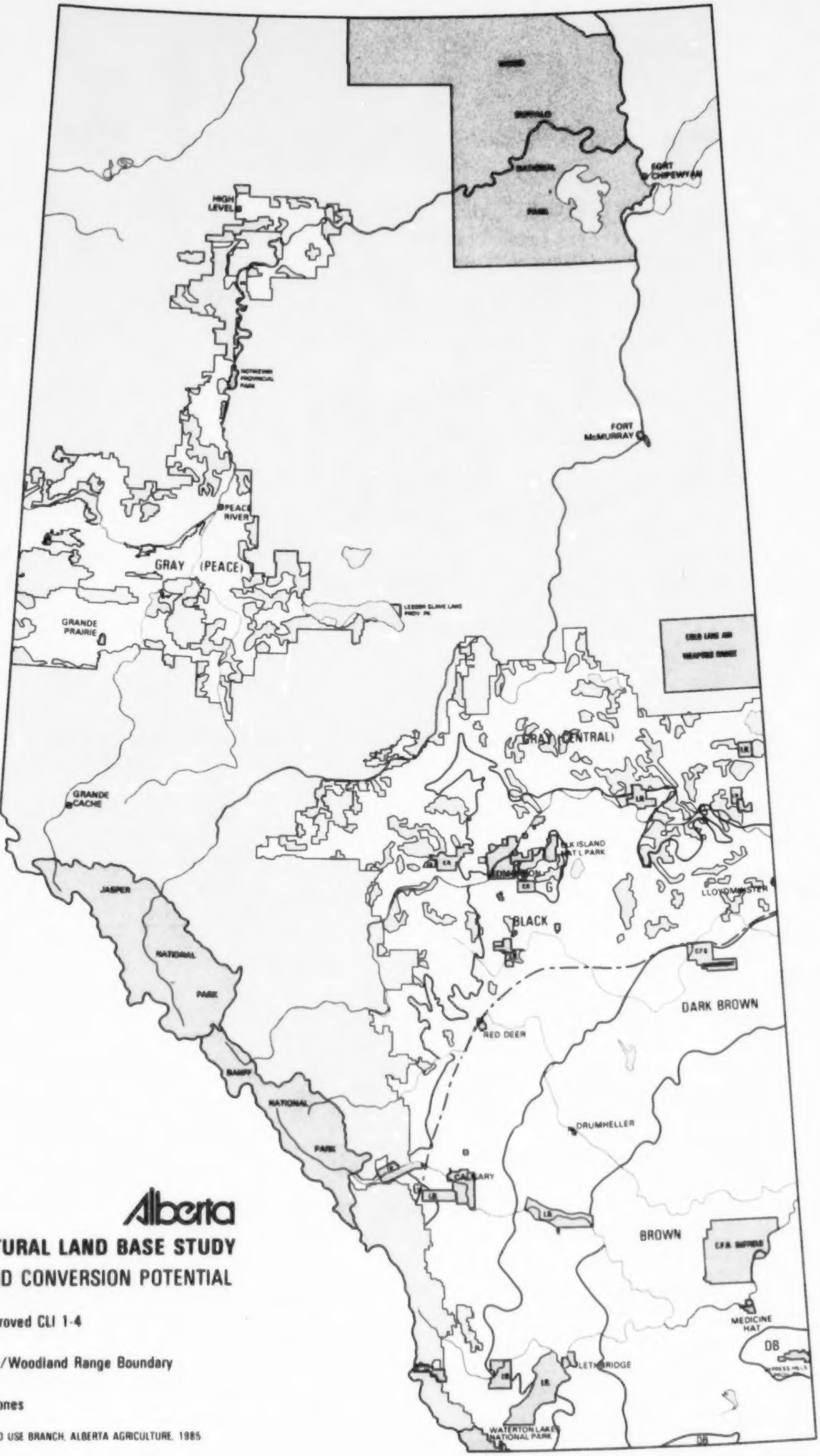
POTENTIAL REDUCTION OF NON-AGRICULTURAL OR UNIMPROVED LAND THROUGH WOODLAND CONVERSION OF LARGE LAREAS OF WOODLAND BY ADMINISTRATIVE REGION.

Administrative Region	Potential Development (000 acres)	Potential Development as Percentage of Non-Agricultural or Unimproved Land in Each Region	Potential Development as Percentage of Non-Agricultural or Unimproved Land Within the Provincial White Area of Each Region
Southern	--	--	--
Central	172	3	3
Eastern Slopes	249	1	26
Peace River	3547	7	86
Northeast	2266	8	41
Provincial Total	6233	6	29

Table 12.2

POTENTIAL REDUCTION OF NON-AGRICULTURAL OR UNIMPROVED LAND THROUGH WOODLAND CONVERSION OF LARGE AREAS OF WOODLAND BY HABITAT REGION.

Habitat Region	Potential Development (000 acres)	Potential Development as a Percentage of Non-Agricultural or Unimproved Land in Each Region
Shortgrass Prairie	--	--
Mixedgrass Prairie	--	--
Fescue Grasslands	--	--
Aspen Parkland	740	28
Montane	9	<1
Subalpine	--	--
Alpine	--	--
Boreal Mixedwood	4855	10
Boreal Foothills	630	4
Boreal Uplands	--	--
Boreal Northlands	--	--
Boreal Subarctic	--	--
Provincial Total	6233	6


BUFFALO
NATIONAL
PARK
FORT CHIPEWYAN
HIGH LEVEL
FORT McMURRAY
PEACE RIVER
GRAY (PEACE)
GRANDE PRAIRIE
COLD LAKE AIR WEAPONS RANGE
GRAY (CENTRAL)
GRANDE CACHE
ELK ISLAND NAT'L PARK
EDMONTON
LLOYDMINSTER
BLACK
G
JASPER
NATIONAL
PARK
DARK BROWN
RED DEER
BANFF
NATIONAL
PARK
DRUMHELLER
CALGARY
BROWN
C.F.B. SUFFIELD
MEDICINE HAT
DB
LETHBRIDGE
WATERTON LAKES NATIONAL PARK

Alberta

AGRICULTURAL LAND BASE STUDY
WOODLAND CONVERSION POTENTIAL

▨ Unimproved CLI 1-4

- - - Prairie/Woodland Range Boundary

—— Soil Zones

SOURCE: LAND USE BRANCH, ALBERTA AGRICULTURE, 1985

PRODUCED BY THE RESOURCE EVALUATION AND PLANNING DIVISION, ALBERTA ENERGY AND NATURAL RESOURCES, 1985

Table 12.3

POTENTIAL REDUCTION OF RESIDUAL WOODLANDS* THROUGH WOODLAND CONVERSION BY ADMINISTRATIVE REGION.

Administrative Region	Area of Residual Woodland Suitable for Conversion (000 acres)	Total Area of Farmland Within Which all Residual Woodland Could be Removed by Conversion (000 acres)
Southern	--	--
Central	158	2 251
Eastern Slopes	26	378
Peace River	257	3 678
Northeast	420	6 000
Provincial Total	861	12 308

* Residual woodlands are found in areas predominantly improved for agriculture.

Table 12.4

POTENTIAL REDUCTION OF RESIDUAL WOODLANDS* THROUGH WOODLAND CONVERSION BY HABITAT REGION.

Habitat Region	Area of Residual Woodland Suitable for Conversion (000 acres)	Total Area of Farmland Within Which all Residual Woodland Could be Removed by Conversion (000 acres
Aspen Parkland	392	5 603
Boreal Mixedwood	411	5 877
Boreal Foothills	58	828
All Others	--	--
Provincial Total	861	12 308

* Residual woodlands are found in areas predominantly improved for agriculture.

Conversion of large parcels of woodland would reduce the availability of unimproved land in four habitat regions. Of these, the most significant effect would be realized in the Aspen Parkland where 28 per cent of all current non-cultivated land could be lost.

Woodland conversion would take up residual woodlands in four administrative regions (Tables 12.3) and three habitat regions (Table 12.4). As indicated on the last column of Tables 12.3 and 12.4, conversion would potentially remove all residual woodlands from very large areas of improved agricultural land. The data in the last column of these two tables was estimated on the assumption that residual woodlands on average make up seven per cent of total on-farm area within the northern portion of the provincial White Area (Statistics Canada 1981). Conversion would remove all wooded areas from approximately 12.3 million acres of improved agricultural land. This 12.3 million acres comprises 41 per cent of the total 30 million acres of improved farmland currently found in Alberta.

Finally, it should be emphasized that the Woodland Conversion alternative entails both the conversion of large tracts of woodland and the conversion of smaller residual woodland areas. The combined effect of these treatments is indicated by adding together the data on Tables 12.1 and 12.3 and adding together the data on Tables 12.2 and 12.4.

12.1.2 Impacts on Wildlife Species in General

Conversion would negatively affect a great many mammal and bird species in the province (Table 12.5). Just over 80 per cent of all mammal species in the Aspen Parkland, Boreal Mixedwood and Boreal Foothills Habitat Regions would be negatively affected. Seventy-two per cent of mammal species in the Montane would be affected. Twenty-five of the 45 mammal species in the province that could be negatively affected, are used for licenced consumptive purposes. Seventy-three to 82 per cent of all breeding bird species, found in the four habitat regions mentioned above, would be negatively affected by conversion. Of the 161 species that could be negatively affected, 22 species are used consumptively. Conversion would negatively affect just over 40 per cent of resident non-breeding birds that winter in the Aspen Parkland.

12.1.3 Impacts on the Potential to Produce a Series of Wildlife Species

The potential for producing close to 21 000 moose would be lost with woodland conversion (Table 12.6). This loss represents 12 per cent of the current provincial potential. Declines in regional capability would occur primarily in the central (-12 per cent), Peace River (-17 per cent) and Northeast (-13 per cent) Regions. Twenty per cent of the best moose habitat in Alberta would be lost as a result of conversion (Table 12.7). Marked regional declines in habitat quality would occur in the Northeast and especially the Peace River regions.

A 13 per cent decline in the provincial capability for mule deer production would occur with conversion (Table 12.6). Significant declines in regional capability would occur in the Central (-11 per cent), Peace River (-22 per cent) and the Northeast (-27 per cent) Regions. Conversion would take up 42 per cent of the best habitat in the Peace River Region and would take up one half of all intermediate quality habitat available in the Northeast Region (Table 12.8).

Conversion would have it's most severe effect on the capability for white-tailed deer production (Table 12.6). Approximately 32 000 deer would be lost. This loss represents 28 per cent of the current provincial capability. Heavy declines in regional capability would occur in the Central (-25 per cent), Peace River (-20 per cent) and especially the North- east (-44 per cent) Regions. Substantial declines in habitat quality would occur in all affected regions of the province (Table 12.9). These declines in habitat quality would likely result in more frequent and more profound occurences of winter mortality for remaining white-tailed deer populations in the province. Similarly, the rate of crop depredation by white-tailed deer would increase.

Table 12.10 indicates the extent to which Woodland Conversion would hinder the achievement of provincial population goals for the ungulates discussed above.

Table 12.5

MAMMAL AND BIRD SPECIES NEGATIVELY IMPACTED BY WOODLAND CONVERSION*

Habitat Region	Mammal Species	Breeding Bird Species	Resident Non-Breeding Bird Species	Migrant Bird Species
Aspen Parkland	$\frac{29}{36} = 81\%$	$\frac{117}{154} = 76\%$	$\frac{4}{9} = 44\%$	--
Montane	$\frac{36}{50} = 72\%$	$\frac{97}{132} = 73\%$	--	--
Boreal Mixedwood	$\frac{37}{45} = 82\%$	$\frac{143}{179} = 80\%$	$\frac{1}{7} = 14\%$	--
Boreal Foothills	$\frac{37}{45} = 82\%$	$\frac{117}{143} = 82\%$	--	--
All Others	--	--	--	--
Provincial Total	$\frac{45}{82} = 55\%$	$\frac{161}{245} = 66\%$	$\frac{4}{13^{**}} = 31\%$	$\frac{0}{25} = 0\%$

* Many individual species occur in more than one habitat region.

** Eight resident non-breeding bird species are also counted as breeding bird species in other regions of the province.

Table 12.6

IMPACTS OF WOODLAND CONVERSION ON THE CAPABILITY TO PRODUCE SELECTED UNGULATES

Net number of animals lost or gained and percentage change relative to total current potential capability.

	ADMINISTRATIVE REGIONS					
	Southern	Central	Eastern Slopes	Peace River	North-East	Provincial Total
Moose	0 (--)	-400 (-12%)	2 000 (-4%)	-12 500 (-17%)	-6 000 (-13%)	-20 800 (-12%)
Mule Deer	0 (--)	-3 600 (-11%)	-1 000 (-3%)	-5 100 (-22%)	-8 400 (-27%)	-18 100 (-13%)
White-Tailed Deer	0 (--)	-6 700 (-25%)	-300 (-3%)	-2 500 (-20%)	-22 700 (-44%)	-32 300 (-28%)

Table 12.7

IMPACTS OF WOODLAND CONVERSION ON MOOSE HABITAT

Net change in the amount of available habitat (000 acres) and percentage change relative to total current habitat.

HABITAT SUITABILITY CLASS	ADMINISTRATIVE REGIONS					
	Southern	Central	Eastern Slopes	Peace River	North-East	Provincial Total
1 (4.9 moose/ 1000 acres)	0 (--)	-10 (-3%)	-325 (-6%)	-1 782 (-42%)	-674 (-21%)	-2 796 (-20%)
2 (1.6 moose/ 1000 acres)	0 (--)	-157 (-31%)	-271 (-3%)	-2 142 (-8%)	-1 050 (-7%)	-3 621 (-7%)
3 (0.4 moose/ 1000 acres)	0 (--)	-214 (-12%)	+168 (+5%)	-1 954 (-12%)	-2 418 (-19%)	-4 419 (-13%)
4 (0.0 moose/ 1000 acres)	0 (--)	+386 (+3%)	+429 (+524%)	+5 973 (+95%)	+4 142 (+48%)	+10 930 (+26%)

Table 12.8

IMPACTS OF WOODLAND CONVERSION ON MULE DEER HABITAT

Net change in the amount of available habitat (000 acres) and percentage change relative to current habitat.

HABITAT SUITABILITY CLASS	ADMINISTRATIVE REGIONS					
	Southern	Central	Eastern Slopes	Peace River	North-East	Provincial Total
1 (4.9 deer/ 1000 acres)	0 (--)	-82 (-2%)	-74 (-4%)	0 (--)	-190 (-11%)	-346 (-3%)
2 (1.6 deer/ 1000 acres)	0 (--)	-2 052 (-30%)	-542 (-4%)	-2 975 (-42%)	-4 630 (-51%)	-10 198 (-25%)
3 (0.4 deer/ 1000 acres)	0 (--)	+289 (+4%)	+533 (+23%)	-779 (-3%)	-352 (-2%)	-308 (<-1%)
4 (0.0 deer/ 1000 acres)	0 (--)	+1 844 increase is from zero	+82 increase is from zero	+3 754 (+21%)	+5 171 (+66%)	+10 852 (+42%)

Table 12.9

IMPACTS OF WOODLAND CONVERSION ON WHITE-TAILED DEER HABITAT

Net change in the amount of available habitat (000 acres) and percentage change relative to current habitat.

HABITAT SUITABILITY CLASS	ADMINISTRATIVE REGIONS					
	Southern	Central	Eastern Slopes	Peace River	North-East	Provincial Total
1 (4.0 deer/ 1000 acres)	0 (--)	-1 195 (-33%)	+40 (+48%)	0 (--)	-5 136 (-57%)	-6 291 (-45%)
2 (1.6 deer/ 1000 acres)	0 (--)	-1 399 (-24%)	-308 (-10%)	-782 (-52%)	-2 491 (-38%)	-4 980 (-26%)
3 (0.4 deer/ 1000 acres)	0 (--)	+2 105 (+25%)	+115 (<+1%)	-3 095 (-13%)	+5 409 (+44%)	+4 534 (+7%)
4 (0.0 deer/ 1000 acres)	0 (--)	+573 increase is from zero	+153 (+6%)	+3 877 (+14%)	+2 452 (+20%)	+7 055 (+16%)

Table 12.10

CHANGES IN PRODUCTION CAPABILITY FOR SELECTED UNGULATES, RESULTING FROM WOODLAND CONVERSION, IN RELATION TO THE "FISH AND WILDLIFE STATUS REPORT".

MOOSE:	
Current Actual Population =	118 000
Actual Population Following Conversion =	103 226
Status Report Goal =	150 000
MULE DEER:	
Current Actual Population =	73 000
Actual Population Following Conversion =	63 810
Status Report Goal =	100 000
WHITE-TAILED DEER:	
Current Actual Population =	118 000
Actual Population Following Conversion =	82 138
Status Report Goal =	125 000

Footnote: See Table 4.9 for an example of how these numbers were calculated.

12.1.4 Effects on Trapping

The extent to which Woodland Conversion would affect registered traplines and resident trappers are estimated in Tables 12.11 and 12.12 respectively. The methods used here to prepare Table 12.11 are as given in Section 4.1.5 while the methods for preparing Table 12.12 are as given in Section 11.1.5.

Conversion would take up two per cent of the total area of registered traplines in Alberta (Table 12.11). Eleven per cent of all traplines in the province could be negatively affected to some degree. Two per cent of all traplines in the province would be lost entirely. The most significant regional effects would occur in the Peace River (16 per cent of all traplines affected) and Northeast (9 per cent affected) Regions. A greater percentage of resident trappers would be negatively affected by conversion. Nineteen per cent of all resident trappers in the province could be lost. Significant regional declines would occur in the number of trappers currently active in the Peace River (44 per cent decline), Eastern Slopes (21 per cent decline), Northeast (20 per cent decline) and Central (10 per cent decline) Regions.

Table 12.11

THE IMPACT OF WOODLAND CONVERSION ON REGISTERED TRAPLINES
(000 acres)

	ADMINISTRATIVE REGIONS					
	Southern	Central	Eastern Slopes	Peace River	North-East	Provincial Total
Total Current Trapline Area	40	152	18 358	52 720	24 343	95 612
Total Number of Traplines	2	4	390	1 017	602	2 015
Total Trapline Area Impacted	--	9%	1%	3%	1%	2%
Total Number of Traplines Impacted	--	100%	2%	16%	9%	11%
Total Number of Traplines Which Would be Lost Entirely With Conversion	--	--	--	3%	5%	2%

Table 12.12

THE IMPACT OF WOODLAND CONVERSION ON RESIDENT TRAPPING ACTIVITY

	ADMINISTRATIVE REGIONS					
	Southern	Central	Eastern Slopes	Peace River	North-East	Provincial Total
Total Current Number of Trappers	342	792	188	494	1 454	3 270
Percent of Total Trappers Lost as a Result of Conversion	0%	10%	21%	44%	20%	19%

12.1.5 Effect on Fisheries

Woodland Conversion would reduce or eliminate many fish populations by causing water quality degradation and by altering stream flow characteristics. Refer to section 12.4 for a brief discussion of the impacts of Woodland Conversion on water resources.

Woodland Conversion would occur in the drainage basins of 16 percent of the total number and 71 per cent of the total area of all fish bearing lakes in the province (Table 12.13). Significant regional effects would occur for fish bearing lakes in the Central, Eastern Slopes, Peace River and Northeast Regions.

No estimate was made as to how many fish bearing streams and rivers would be negatively affected by conversion. A large number of watercourses in central and northern Alberta would be affected.

Table 12.13

IMPACT OF WOODLAND CONVERSION ON KNOWN FISH BEARING LAKES BY ADMINISTRATIVE REGION

ADMINISTRATIVE REGION	Percent of total number and percent of total area (acres) of all fish bearing lakes in each region, which have some potential for woodland conversion within their basins.*
Southern	Number = $\frac{0}{73}$ = 0% Area = $\frac{0}{104\ 379}$ = 0%
Central	Number = $\frac{7}{75}$ = 9% Area = $\frac{34\ 959}{112\ 745}$ = 31%
Eastern Slopes	Number = $\frac{16}{186}$ = 9% Area = $\frac{23\ 249}{83\ 593}$ = 28%
Peace River	Number = $\frac{19}{139}$ = 1% Area = $\frac{346\ 404}{777\ 366}$ = 45%
Northeast	Number = $\frac{105}{330}$ = 32% Area = $\frac{2\ 274\ 086}{2\ 710\ 576}$ = 84%
Provincial Total	Number = $\frac{129}{803}$ = 16% Area = $\frac{2\ 678\ 697}{3\ 788\ 658}$ = 71%

* This analysis considers only the conversion of large continguous areas of currently unimproved land. See section 12.1.1.

12.1.6 General Considerations

Woodland Conversion would substantially reduce the diversity and abundance of wildlife in central and northern Alberta much like Range Conversion. A great many species would be negatively affected by conversion, while it is difficult to list more than a few species that would benefit from this treatment option.

Conversion would have it's greatest effect on the current settled areas of the Central, Peace River and Northeast administrative regions. As noted above, concentration of conversion activity in these areas would make it more difficult for people in the population centres of northern and central Alberta to access wildlife populations and larger contiguous areas of wildlife habitat. Viewing and consumptive use of certain wildlife species on remaining areas of wildlife habitat would, in many instances, be more difficult due to the relatively low carrying capacity of those areas. Also, Woodland Coversion would eliminate or reduce the quality of many fisheries which are currently accessible to residents of northern and central Alberta. Finally, it is apparent that the conversion of residual woodlands would leave large areas of farmland in the province relatively devoid of habitat for many bird and mammal species.

12.2 Timber Resources

The effects of Woodland Conversion on timber resources would be limited to Community Farm Woodlots (CFWs) (Table 12.14). Impacts would generally only affect small portions of CFWs. The exception is Edson where about 50 per cent of the area could be affected.

Table 12.14

PERCENT OF EXISTING OR PROPOSED CFWs
LOST UNDER WOODLAND CONVERSION

Existing Woodlot	% of Area	Proposed	% of Area
Child Lake	10	Edson	50
Tompkins	10	Chip Lake	40
McLennan	10		
Hines Creek	10		
Worsley	5		
Puskwaska	10		
Snipe Lake	5		
Edson	50		

12.3 Public Rangeland Resources

The conversion of arable woodlands on 350 000 acres of public land in the White Area could displace about 61 500 AUMs. These losses would mainly occur in the Northeast and Peace River Regions (Tables 12.15). The area potentially affected is about 5 per cent of the provincial total of public rangelands in the White Area (excluding the Special Areas) and about 3 per cent of the total AUMs on this land.

Table 12.15

REGIONAL SUMMARIES OF WOODLAND CONVERSION IMPACTS
ON GRAZING ON PUBLIC LAND IN THE WHITE AREA
(EXCLUDING SPECIAL AREAS)

ENR Region	Acres CLI 1-4 currently disposed to grazing (000 acres)	AUMs potentially lost on CLI 1-4
Central-Eastern Slopes	30	9 000
Northeast	170	29 000
Peace River	150	23 000
Total Affected	350	61 000
Provincial Totals	7 287	1 874 000
Percentage of Provincial Total	5	3

12.4 Water Resources

The impacts of Woodland Conversion on water resources are similar to those associated with converting agricultural land in the Green Area (see also section 4.6). Problems related to erosion, water quality degradation, and changes in streamflow can be expected as woodlands are cleared and brought under cultivation. Much of this area consists of virgin forests on similar soils as those found in the Green Area and therefore similar concerns with regard to erosion susceptibility and drainage problems are possible.

Specific areas of concern in terms of erosion susceptibility are those areas south and west of Lesser Slave Lake and lands in the Smoky River basin. In these areas undulating topography and fine textured soils have led to soil erosion from cleared land and have required the construction of erosion control projects such as those located on the East-West Prairie Rivers. Further clearing in these regions would likely intensify these problems as increased silt loads and greater water volumes would be carried into area streams.

In central Alberta almost 4 million acres of woodland could be available for cultivation. Factors which have constrained agricultural developent in the past include: stoniness, poor soil structure, hilly topography, and excessive moisture. Cultivating land with some or all of these limitations would likely lead to soil erosion, particularly in hilly areas, drainage problems in wet areas and water quality degradation in lakes draining large areas of converted land.

Specific problem areas can be identified by referring to the map of soil erosion potential (Figure 9). In central regions a fairly strong correlation exists between the areas available for conversion and the areas with high erosion potential, indicating that erosion may be a major concern if these lands were opened for agriculture. Water quality could be a concern in the Wabamum and Lac Ste Anne basins where large areas are outlined for conversion and the resulting increase in phosphorus loadings will have severe impacts on the lakes. Similar concerns exist in the Beaver River basin where Woodland Conversion could produce phosphorus loadings similar to those predicted in the range improvement option, and would in all likelihood lead to significant exceedance of water quality criteria at the Saskatchewan border.

13. SALINE SOIL RECLAMATION

Saline soils are scattered in patchy areas throughout the Province but are most commonly found in south and southeast Alberta. Historically, saline seeps occur naturally as a result of processes which cause soluble salts to occur at or near the surface of the soil. Salinity is often the result of man's activities. Summerfallowing, water and snow accumulation, irrigation, deforestation and overgrazing are all responsible for the increased development of saline seeps. It has been estimated that approximately 2.5 million acres of salt affected land could be reclaimed through proper management, 2.22 and 0.25 million acres for dryland and irrigated salinity respectively (Figures 20 and 21).

No potential impacts on other resources have been identified for dryland saline reclamation; impacts discussed below pertain to the reclamation of irrigated saline soils.

13.1 Water Resources

13.1.1 Water Quality

Sub-surface drainage is recognized as the most effective method of controlling salinity on irrigated saline soils in Southern Alberta. This technique involves the installation of perforated plastic tubing at depths of 1-1.5 m and spacings of 15-30 m in the saline seep area, and the irrigation and cropping of the area with a salt resistant crop. The irrigation water applied has the effect of leaching out accumulated salts in the upper soil layers and carrying them out of the soil with drainage effluents. It is this removal of salts which has potentially serious implications for the river systems of Southern Alberta and will be discussed in this analysis.

The major water resource impact associated with subsurface drainage is the effects that poor quality effluents have on receiving streams. A number of studies undertaken in Southern Alberta have measured the quality of drainage effluents and have indicated generally high levels of dissolved salts (Harker 1980). The results of the sampling program are illustrated in Table 13.1. The mean electrical conductivity of 5.7 ms/cm represents very saline water and would far exceed any of the specific use water quality objectives defined in the South Saskatchewan River Basin Study.

Table 13.1

TILE EFFLUENT VALUES FROM 21 TILE SITES SAMPLED OVER THREE YEARS (1977-1979)

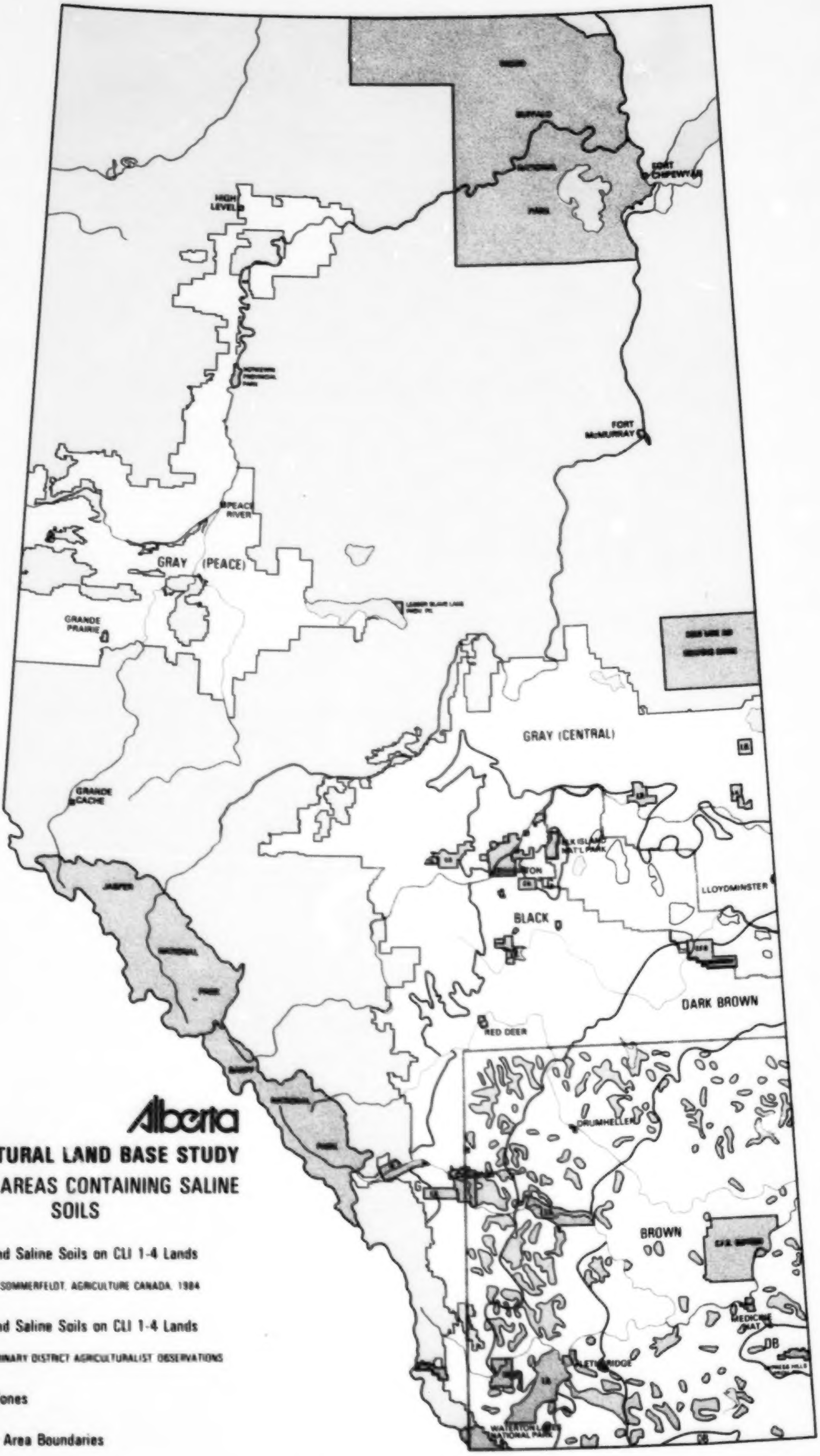
Factor	Range	Mean
Flow/L/s*	0 - 12	0.49
EC mS/cm+	0.9 - 17.1	5.7
SAR++	0.2 - 23.6	7.0

* L/s - litres per second
+ mS/cm - electrical conductivity in millisiemens/centimeter
++ SAR - sodium absorption ratio

Source: D.B. Harker 1980. Projected Tile Effluent Effects on the Oldman River.

The Harker study goes on to project the effects that tile effluents could have on surface water quality in the Oldman Basin. Current estimates indicate that 150 000 acres of land requires subsurface drainage in the Oldman Basin alone, and if drained would add a salt load of 308 000 tonnes to the river during April to October. During average flows on the Oldman this additional load would not be a problem since it would raise TDS levels to about 300 mg/L which is still good quality water. However at low flows salt loads could rise by 200 per cent in the river, producing TDS levels of 750 mg/L which is approximately equal to that of the Colorado River and would represent a serious deterioration of water quality. Further projections of other combinations of extreme low flows and poor effluent quality indicate that even more serious water quality reductions could occur under certain conditions.

The results of this analysis indicate that there is some cause for concern with regards to the water quality effects of drainage effluents. The most severe water quality problems would be experienced in the Oldman Basin since it contains the majority of saline soils and flow variability is such that drainage effluents may cause frequent problems in the future. In the Bow and Red Deer basins extreme low flows are less frequent and with a smaller acreage of saline soils, salinity levels would likely remain acceptable in these rivers.


HIGH LEVEL
FORT CHIPEWYAN
FORT McMURRAY
PEACE RIVER
GRAY (PEACE)
GRANDE PRAIRIE
GRANDE CACHE
GRAY (CENTRAL)
LLOYDMINSTER
BLACK
RED DEER
DARK BROWN
DRUMHELLER
BROWN
MEDICINE HAT
LETHBRIDGE
WATERTON LAKES NATIONAL PARK
JASPER NATIONAL PARK
BANFF NATIONAL PARK
DB

Alberta

AGRICULTURAL LAND BASE STUDY

DRYLAND AREAS CONTAINING SALINE SOILS

▨	Dryland Saline Soils on CLI 1-4 Lands

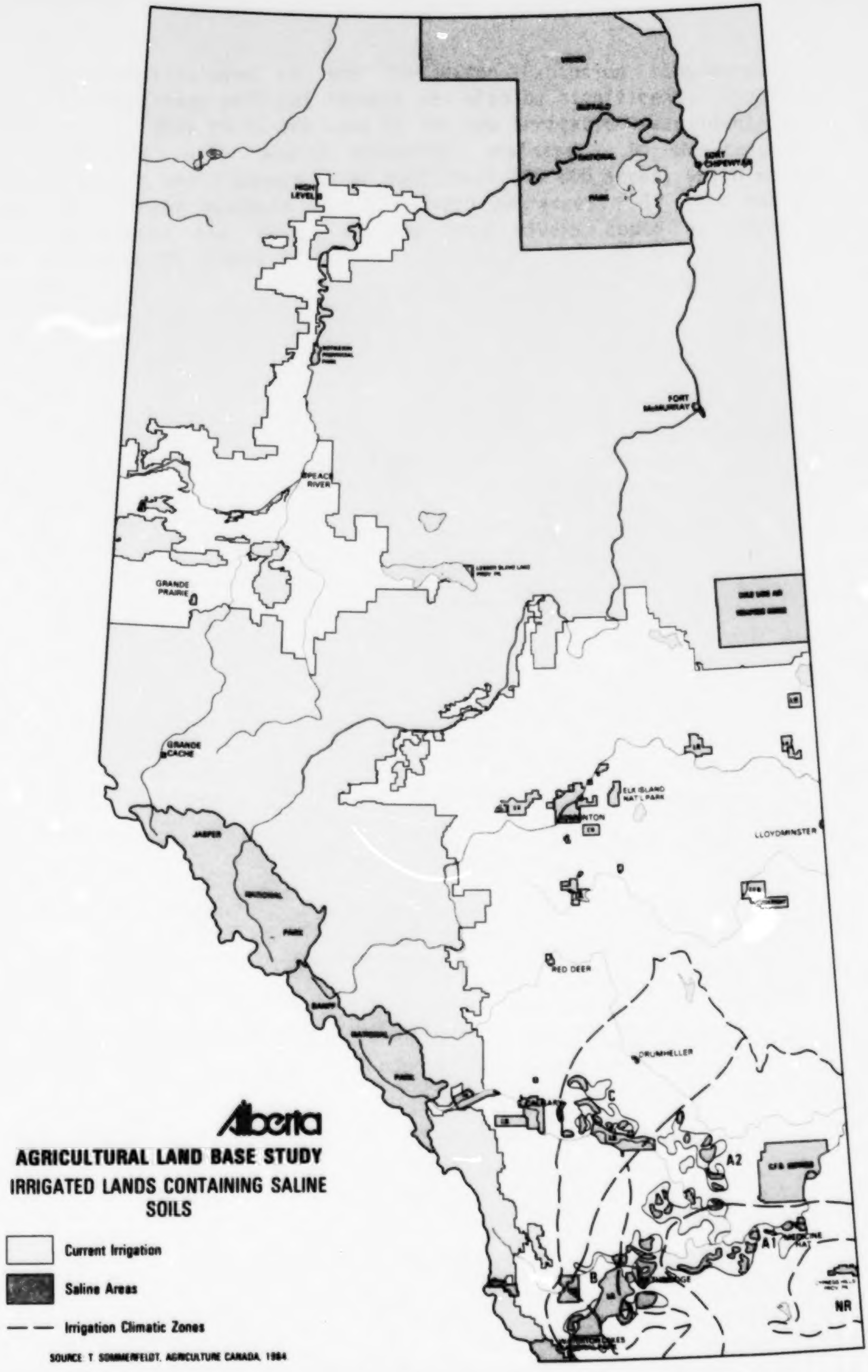
SOURCE T. SOMMERFELDT, AGRICULTURE CANADA, 1984

☐	Dryland Saline Soils on CLI 1-4 Lands

SOURCE: PRELIMINARY DISTRICT AGRICULTURALIST OBSERVATIONS

—	Soil Zones
—	Study Area Boundaries

PRODUCED BY THE RESOURCE EVALUATION AND PLANNING DIVISION, ALBERTA ENERGY AND NATURAL RESOURCES, 1985



HIGH LEVEL
FORT CHIPEWYAN
WOOD BUFFALO NATIONAL PARK
FORT McMURRAY
PEACE RIVER
LESSER SLAVE LAKE PROV. PK.
GRANDE PRAIRIE
GRANDE CACHE
ELK ISLAND NAT'L PARK
EDMONTON
LLOYDMINSTER
JASPER NATIONAL PARK
RED DEER
BANFF NATIONAL PARK
DRUMHELLER
C
A2
CFB SUFFIELD
A1
MEDICINE HAT
B
LETHBRIDGE
CYPRESS HILLS PROV. PK.
NR
WATERTON LAKES
Current Irrigation
Saline Areas
Irrigation Climatic Zones

Alberta

AGRICULTURAL LAND BASE STUDY
IRRIGATED LANDS CONTAINING SALINE SOILS

SOURCE: T. SOMMERFELDT, AGRICULTURE CANADA, 1984

PRODUCED BY THE RESOURCE EVALUATION AND PLANNING DIVISION, ALBERTA ENERGY AND NATURAL RESOURCES, 1985

The implications of the Irrigation Expansion considered in Chapter 5 on drainage effluent impacts may also be significant. The SSRB study estimates that 20-25 per cent of the new irrigated areas identified in the scenarios will require subsurface drainage. In the case of Scenario 4C this would amount to an additional 250 000 acres, which would double the current estimate of 200 000-250 000 acres. If this entire area was drained the impact on the area rivers could be severe, particularly on the Oldman River.

14. SUMMARY

The preceding analysis was conducted to determine some of the inter-relationships between agricultural development and the use and management of land and water resources in Alberta. The ten development alternatives under consideration produce different levels of impacts depending upon the extent to which agricultural use competes for the resource base required by other uses. This competition may be a direct conflict over the development of land currently used for timber or wildlife production or the indirect effects of agricultural practices on soil and water quality.

Since agriculture affects such a diverse range of resources and resource users, it is difficult to evaluate the relative severity of impacts produced by the development options. These various impacts can not be added within resources or among other resources. The loss of an acre of prime wildlife habitat, a stand of timber, or an inch of topsoil cannot be compared in any direct manner. Similarly a unit of non-agricultural land in southern Alberta that may be affected by Prairie Range Conversion is not directly comparable to a unit of non-agricultural land in the northwest which may be lost to agricultural expansion into the Green Area. The only universal measure available to compare the development alternatives and their impacts, is the monetary value associated with them. These values are assessed and compared in the Economic Impact Analysis report. It must be emphasized that many of the impacts described in this report can not be given monetary values, but they still remain important and must be considered even if in a qualitative or quantitative manner.

The major impacts of the various alternatives and some of the mitigative measures available to reduce the severity of these impacts are summarized by the six primary resources as follows:

14.1 Fish and Wildlife Resources

Agricultural development has substantially altered the ecological characteristics of many landscapes found in Alberta. These changes have largely reduced the diversity and abundance of fish and wildlife species in the province. Table 14.1 summarizes the impact

Table 14.1

AMOUNT OF NON-AGRICULTURAL OR PREDOMINENTLY UNIMPROVED LAND CURRENTLY FOUND WITHIN EACH HABITAT REGION, IN RELATION TO THE AREA OF ALL SUCH LAND ORIGINALLY AVAILABLE IN EACH REGION

HABITAT REGION	Total Area of Current Non-Agricultural Land as a Percent of Total Habitat Region Area (000 acres)
Shortgrass Prairie	$\frac{5\ 727}{10\ 593} = 54\%$
Mixedgrass Prairie	$\frac{1\ 853}{6\ 925} = 27\%$
Fescue Grasslands	$\frac{757}{2\ 880} = 26\%$
Aspen Parkland	$\frac{2\ 611}{14\ 961} = 17\%$
Montane	$\frac{1\ 271}{1\ 362} = 93\%$
Subalpine	$\frac{3\ 308}{3\ 308} = 100\%$
Alpine	$\frac{1\ 673}{1\ 673} = 100\%$
Boreal Mixedwood	$\frac{46\ 963}{58\ 749} = 80\%$
Boreal Foothills	$\frac{15\ 900}{17\ 738} = 90\%$
Boreal Uplands	$\frac{7\ 752}{7\ 752} = 100\%$
Boreal Northlands	$\frac{12\ 194}{12\ 194} = 100\%$
Boreal Subarctic	$\frac{5\ 254}{5\ 254} = 100\%$

regions of the province. From Table 14.1 it is evident that most of the Mixed Grass Prairie, Fescue Grasslands and Aspen Parkland have already been given over to improved agricultural development. Substantial development has also occurred in the Shortgrass Prairie. Smaller portions of the Boreal Mixedwood, Boreal Uplands and Montane Habitat Regions have been improved for agriculture. As an addendum to Table 14.1, it should be realized that grazing by domestic livestock probably occurs on almost all of the remaining non-agricultural or predominently unimproved land found in the Parkland and Prairie Habitat Regions of the province.

The data provided in Table 14.1 should be taken into account in evaluating the impact of the agricultural development options considered in the Agricultural Land Base Study. Special attention should be given to development options which impact remaining undeveloped areas in the Parkland and Prairie Habitat Regions of the province since these regions have already been largely taken up by agriculture.

As indicated in the Executive Summary of this report, it has been estimated that each of the Green Area Conversion, Woodland Conversion, Prairie Range Conversion and Drainage alternatives would have a high negative affect on fish and wildlife resources in the province. Expansion onto Green Area land would develop a very large area of the province for agriculture thereby negatively affecting a great many fish and wildlife species. Similarly, Woodland Conversion would also improve a large area for agriculture. This treatment would take up much of the remaining unimproved Aspen Parkland. By removing large blocks of woodland and removing smaller residual woodland areas, this treatment would leave much of the settled region of northern and central Alberta essentially devoid of wildlife. Prairie Range Conversion would take up a good deal of the remaining unimproved land in the Short Grass Prairie, Mixed Grass Prairie, Fescue Grasslands and Aspen Parkland. This treatment would harm a substantial number of species and would significantly reduce the availability of fish and wildlife resources in central and southern Alberta. In current agricultural areas drainage would reatly reduce the diversity of wetland and upland habitat types available to a great many species. Most wildlife species in the province would be negatively affected by drainage. As much as 20 per cent of the fall population of waterfowl would be removed in the Northeast Region.

Irrigation Expansion and Range Improvement would also have a moderate negative affect on fish and wildlife resources. Irrigation Expansion would take up a moderate amount of unimproved land in southern Alberta but would negatively affect most wildlife species currently found in southern Alberta. Range Improvement would take up a moderate amount of non-agricultural land throughout various regions of the province and would negatively affect many wildlife species in the province. It would produce a significant regional decline for many species in southern and central Alberta.

Saline Soil Reclamation would each have a relatively low negative effect on fish and wildlife resources. By degrading water quality, saline soil reclamation would have local and regional negative affects on fisheries resources.

Finally, although not discussed in the preceeding report, it should be noted that Summerfallow Reduction would have an insignificant positive impact on some wildlife species by providing increased forage.

Several of the agricultural development alternatives noted above would individually alter the character of fish and wildlife resources and wildland resources in Alberta. The combined impact of two or more of the above alternatives would be very dramatic. As noted elsewhere in this report, it is inappropriate to add together the identified impacts of individual agricultural treatment alternatives. Such an addition violates several assumptions implicit in the preparation of this report. However, it is obvious that striving for maximum agricultural production, using various development alternatives applied to various regions of the provinces weuld substantially deplete the fish and wildlife resources of the province. The precedent for expecting such a loss of fish and wildlife resources has been reported in various areas of the United States. For example, the intensification and expansion of agriculutre in Illinois during the past several decades has created a "crisis" situation for wildlife habitat in that state (Illinois Wildlife Habitat Commission, 1985).

Some, but definately not all, of the above impacts can be mitigated to some degree. Reducing the severity of some of the impacts on fish and wildlife would predominantly involve holding back areas of prime habitat from agricultural development. Fish and wildlife habitat can also be preserved within agricultural areas through the preservation of woodlots, shelterbelts and wetlands (it must be noted that some of the alternatives actually address the removal of these landscapes). Some measures may help to maintain species such as deer, small mammals and waterfowl in a limited manner; however, larger ungulates such as moose, elk, and caribou will inevitably suffer population reductions as their habitat is converted to agricultural uses.

14.2 Timber Resources

The major impacts of agricultural development on timber resources are limited to the northern regions of the province where agfricultural and forest land uses compete for the same resource base. The most serious loss of forest production capability could occur in the southern Peace-Edson-Whitecourt area and the northern Peace-High Level region. In these areas 20 to 30 per cent of total area and volume of forest could be lost to agricultural expansion in the Green Area. Within the White Area the only impact on timber resources would occur locally in community farm woodlots affected by Woodland Conversion and Woodland Range Improvement.

There is little in the way of mitigative options which can reduce the impact of clearing land in the Green Area and therefore if the entire 9.2 million acres of land is developed the province could expect to lose approximately 8.0 per cent of its coniferous timber volume and 25 per cent of its deciduous timber volume.

14.3 Public Rangeland Resources

Grazing of domestic cattle on public land in the White and Green Areas provide an important resource to the cattle industry in Alberta. Green Area Conversion, Irrigation Expansion, Prairie Range Conversion and Woodland Conversion could each displace a portion of this activity. The Range Improvement alternative could result in a gain of 225 000 AUMs. Impacts on public rangeland in the White Area are generally less than 10 per cent of the provincial total, but of perhaps greater importance is the potential effect on the ranching lifestyle in Alberta.

Impacts on public rangelands could be reduced through the preservation of important rangeland or intensifying use of remaining resources.

14.4 Recreation Resources

The recreation resources discussed in this report consist of forest recreation areas managed by the Alberta Forest Service and rivers and lakes which have recreation potential for water based activities. Alberta Forest Service recreation areas are relatively small, localized sites which can easily be withheld from agricultural development. The impacts on rivers and lakes, however, may be more severe and less easily mitigated since the problem of water quantity and quality changes is related to eight of the 11 alternatives. The reduction of flows in the three southern river basins may cause some problems for river based recreationists such as boaters, swimmers and sport fisherman while in the north the eutrophication of lakes by agricultural runoff has the potential to seriously restrict the use of these lakes for contact and non-contact recreation.

Many of these water quality impacts could be alleviated to some degree by on-farm management techniques.

14.5 Soil Resources

The impact of agricultural development on the soil resource is one of the major concerns in 4 of the 11 alternatives. The conversion of Green Area and wooded White Area land to agricultural uses could lead to significant increases in soil erosion unless soil conservation measures are taken by the farmer. Water erosion would be most serious in central and northern Alberta, especially on Green Area land where the combination of highly erodible soils, undulating topography and abundant moisture create a substantial potential for soil loss on cleared land. Agricultural drainage in northern Alberta would also drastically increase rates of soil erosion in drainage ditches and fields particularly in the Peace River region. In southern Alberta wind erosion is more prevalent, particularly during periods of drought. In the drought year of 1985 it is estimated that 800 000 to 1 million acres of land in the southern third of the province was adversely affected by wind erosion. Another concern which is predominant in southern Alberta is the problem of soil salinity induced by irrigation or dryland farming. Any increase in the area of improved land will increase the area of saline soils, eventually requiring the use of corrective measures such as sub-surface drainage or vegetative controls.

Unlike other impacts examined in this report, management practices adopted by farmers cause most of the erosion that threatens productivity. However farmers can adopt practices which will reduce the risk of erosion and enhance the soil's productivity. Trash cover, shelter belts, barrier strips of one or two rows of tall grasses, and strip cropping with crops alternating at right angles to prevailing winds protect soils from wind erosion by reducing wind velocities at the soil surface. Management practices designed to reduce water erosion increase the moisture holding capacity of the soil or control the movement of excess water off the land. Such practices include contour farming and grassed waterways to reduce gully erosion, and the reduction of summerfallow and conservation tillage to maintain crop residues at the soil surface thereby reducing sheet and roll erosion. In terms of agricultural drainage all major projects must meet high standards of erosion protection. These standards could also be implemented for on-farm drainage to ameliorate soil erosion.

14.6 Water Resources

In reviewing the impacts of the various alternatives on water resources, it is apparent that one of the most important concerns could be the effects of soil erosion on water quality in rivers and lakes. The clearing and cultivation of wooded and native grasslands would lead to significant increases in soil erosion rates in four of the agricultural options (Green Area Conversion, Range Improvement, and Prairie Range and Woodland Conversion). Increased sedimentation and possible water quality deterioration could be expected in much of northern and central Alberta with major impacts concentrated in the Peace, Athabasca, and Beaver River basins. In these basins substantial deterioration in fish habitat, municipal water supply, recreational use and the aesthetic value of the area's rivers and lakes could be expected.

The other major impact associated with clearing and cultivation of forested land is the changes in runoff volumes and timing which occur after clearing. These changes produce higher flows, often resulting in erosion in previously stable streams, they may also produce flashier runoff with higher flood peaks and reduced low flows. The drainage of wetlands is also a major concern both in terms of lost wildlife habitat, and the loss of the beneficial attenuation of flooding and low flows by wetland storage.

The expansion of irrigated land in Southern Alberta raises a different set of concerns for water resources, the primary one being the effects on river quality of withdrawing large volumes of water for irrigation and returning salt laden effluents. The combination of two development alternatives: Irrigation Expansion and the Saline Soil Reclamation; has the potential to produce serious effects on water quality in the Bow and Oldman Rivers. These alternatives produce a number of water quality impacts which may be difficult to mitigate. Low flows related to irrigation withdrawals are currently being experienced and can only be mitigated by the construction of additional storage reservoirs. Water quality concerns related to salt loading can be reduced by maintaining river flows at sufficiently high levels to dilute effluents or by creating sdalt sinks where drainage waters can be collected. In both cases maintaining flows high enough to minimize impacts and to provide sufficient irrigation waters may be difficult and would likely be one of the major concerns associated with Irrigation Expansion.

Some of the other impacts of agricultural development on water resources can be alleviated through comprehensive planning before development takes place. The off-farm drainage and erosion impacts can be alleviated with effective planning and design of drainage networks to provide sufficient outlet for flood flows, and to include erosion control measures such as culvert chokes, drop structures and bank stabilization. These measures also reduce the water quality impacts of sediment and nutrient loading since sediment levels are directly related to erosion rates, and nutrients such as Phosphorus and Nitrogen are bound to the sediments and transported with them. The maintenance of buffers can also aid mitigation of impacts.

SUMMARY

Large scale agricultural development could significantly affect the use of Alberta's land and water resources by other sectors and the conservation of those resources for future use. The potential impacts from each of the 10 development options in the Agricultural Land Base Study have been identified and described. Major impacts would be expected on wildlife and timber. Major impacts could also occur on soil and water resources if mitigation measures are not implemented. Relatively minor impacts could occur on public rangeland and recreation.

Significant positive impacts could be created by two of the development opportunities. Green Area Conversion would result in the development of a transportation and utility infrastructure in Northern Alberta which would benefit non-agricultural sectors. Irrigation Expansion would create a secure water supply for municipal and industrial users in Southern Alberta. This would lead to a stabilization of agricultural production and an increase in water based recreation opportunities. It could also improve soil quality in some salinized area. However, at the provincial level, the potential exists for major negative impacts on wildlife and timber resources if alternatives such as Green Area Conversion, Irrigation Expansion, Drainage Woodland Conversion and Range Conversion are pursued. If implemented mitigation and conservation measures could offset the impacts on soil and water resources and to a small extent those on wildlife resources for these alternatives. Deep Plowing, Liming Soils and Summerfallow Reduction would produce no impacts while Range Improvement and the Reclamation of Saline Soils would produce lesser impacts on smaller areas of the land base.

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